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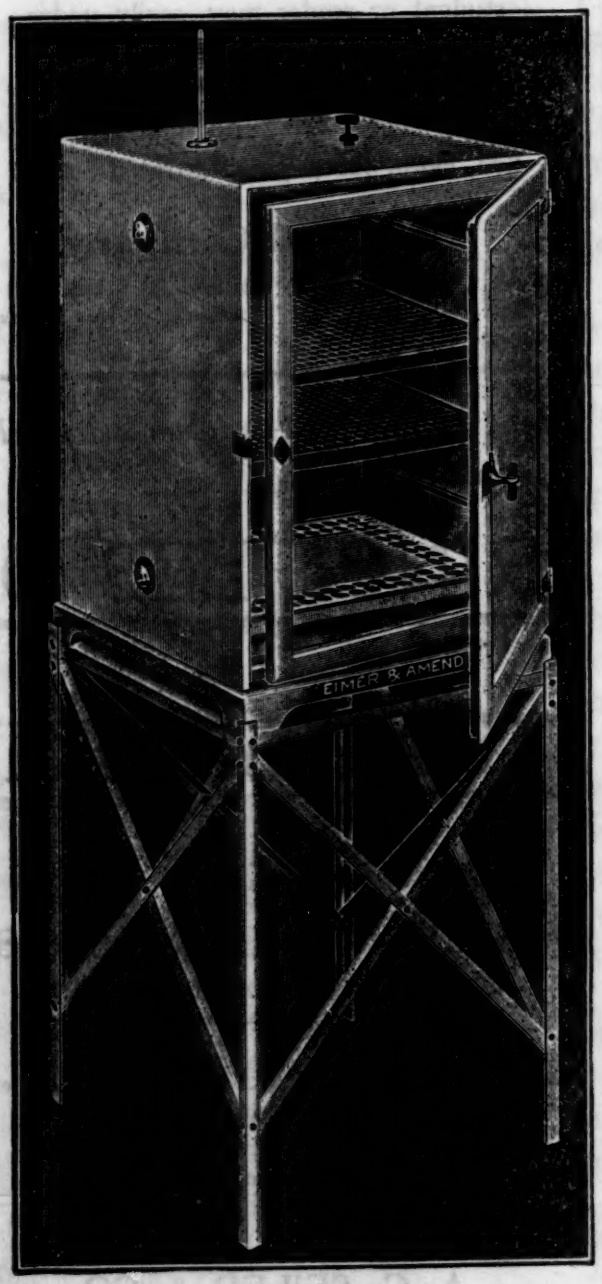

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THE BASIS OF INDIVIDUALITY IN ORGANISMS[1]

INTRODUCTORY

To enter upon the "higher criticism" of the concept individuality, is far beyond my powers. Even the humble attempt to think of it, in the organic realm, in what I conceive to be the simplest terms, offers difficulties most of which must be bequeathed in their entirety to future generations. Yet to point these out and to take a few soundings, unsatisfactory though they be, may not prove entirely futile even at this time.

For me, the basis of individuality in organisms is the mechanism by which living things, despite profound and constant change, keep themselves capable of identification. Some of the changes through which organisms pass are so radical that by common consent we treat them separately under the head of development, but since there is no evidence that living things become individuals at a particular point in their history, we may expect to find anywhere in the life-cycle the mechanism upon whose workings the possibility of identification rests. For obvious reasons the arrangements that make for constancy must occur in their least complicated form in the simplest of all the stages of development.

Fortunately, since it forces us at once to engage with fundamentals, the beginnings of development offer no refuge from our most insistent problem. We habitually identify a given organism at two more or

[1] Read at a joint symposium of the American Society of Zoologists and Section F of the American Association for the Advancement of Science, Columbus, Ohio, December 30, 1915.

less remote points of time, but no biologist limits himself to this relatively simple pursuit, since every living thing can be, at least partly, identified also with the better known portions of its ancestry. Indeed, these so-called genetic similarities are so striking and constant that one generation can be inferred from another with considerable precision.

If there is a substantial basis for the resemblances between parents and offspring, it must be the chromatin, for this is the only material capable of being contributed to each generation in essentially equivalent values by all the members of a given lineage. But if chromatin is responsible for the partial identifications possible between the individuals of two or more generations, we must also suspect that the specific recognition of a given individual at any of the numerous phases of his life is traceable to the same source.

THE SYNTHESIS OF CHROMATIN

Strictly speaking, "chromatin" is a morphological concept. Chemical analysis shows that it contains a conjugated phospho-protein provided with a nucleic acid group, the latter a complex of phosphoric acid and a nuclein base. During the so-called resting state of the cell, this material appears segregated in the nucleus.

We must attach to this substance a degree of specificity not less exact than the specificities we are seeking to explain. In this we have ample encouragement from cytologists and geneticists. But the question at once arises how chromatin can increase in quantity during more than one life cycle and yet lose none of its original characteristics. Brothers, who in the one-celled state derived from their mother the kind or arrangement of chromatin which in her father was associated with color-blindness, not only exhibit this defect in their own persons, but between the ages of 25 and 55 produce each some 169,692,750,000 examples of the same factor, all traceable to their own original endowment.

Compared with cytoplasm, the nucleus seems meager in the diversity of its chemical make-up. It is free from salts; it is devoid of fats and carbohydrates. Moreover, iron and phosphorus, easily demonstrable in the cytoplasm, are present in nuclei in forms difficult to detect and for that reason spoken of as masked or organic. These facts are not altered by doubting the localization of the iron in chromatin[2] or the accuracy of the tests for organic phosphorus.[3]

From the constancy of their occurrence we must conclude that both elements, as nuclear constituents, are essential. However, their absence in inorganic form, coupled with the general chemical poverty of the nucleus, indicates that simple raw materials for the synthesis of chromatin are excluded by the nuclear membrane (Macallum).

This conclusion is out of harmony with prevalent interpretation. Yet no one need be misled. That nuclei are rendered conspicuous by staining, are scrupulously divided in cleavage and maturation, and combined with equal exactitude in fertilization, are all beside the point. Further, though no cell devoid of a certain proportion of nuclear material can live, it is no less true that a nucleus embarrassed by the loss of cytoplasm also fails to maintain itself. Chromatin, moreover, is present in the bacteria, but not in the form of a nucleus. Here its complete cytoplasmic synthesis is not open to doubt. We are ready enough to admit that the cytoplasm of nu-

[2] References in Aristides Kanitz, "Handbuch d. Biochemie," etc. Herausgegeben von Carl Oppenheimer, pp. 253–254, Bd. II., Teil 1.

[3] R. R. Bensley, *Biological Bulletin*, Vol. X., pp. 49–65.

cleated cells can synthetize fats, carbohydrates, and proteins in general, including the most complicated compound forms. What real evidence have we that nucleoproteins constitute the sole exception?[4]

If we reckon with the synthetic powers of the cytoplasm as a possibility, we must next inquire how these can be influenced by the presence of a specific nucleus. That cytoplasmic response, in general, is dependent on the chemism of the cell, and that these activities are specifically and profoundly modified by changes in the variety of nuclear material present, are well-known facts shown nowhere more clearly than in the structural differentiations called forth in hybrids. These, especially, are important for us since the introduction of nuclei into foreign cytoplasm demonstrates most strikingly their ability to regulate syntheses so that more nuclei like themselves are produced. In what terms are we to conceive this regulation?

The influence of a specific chromatin on cellular processes can be directly attributed to the samples which are known to leave the nucleus and come directly into the cytoplasmic reaction-sphere. But the details of their activity there remain obscure. Autocatalysis, suggested on quite inadequate grounds, is not necessarily excluded by the recent work of Conklin[5] and other effects are also thinkable. A fitness, chemical or physical in nature, between the liberated chromatin or its products, on the one hand, and certain of the reaction-products of cytoplasmic synthesis on the other, leading to the formation of different, or larger, non-reacting aggregates, would automatically increase the production of such substances, provided always the machinery necessary for their production is given at all. Very possibly the reciprocal relation suggested here is one of the keys to successful hybridization.

It is useless to hope for intellectual satisfaction in this matter at the present time. We can, however, assert with confidence that a cell is viable and assured of the possibility of offspring, essentially like itself, if it contains, at the beginning of its life-cycle, samples of all the various kinds of chromatin possessed by its immediate parent, and moreover, contains these in quantities sufficient to influence cytoplasmic syntheses so that they shall ultimately yield a chromosomal complex in which the original proportions among the several variants are quantitatively preserved.

THE SYNTHESIS OF CHROMOSOMES

If chromatin or its immediate forerunners are cytoplasmic in origin, how do they get into the nucleus? The impermeability of nuclear membranes for most constituents of the cell is probable; likewise, their permeability for nucleins, since these, even in the form of visible aggregates, seem to pass freely into the cytoplasm. If they can get through the membrane, going out, they can also get through, going in. The nucleus, therefore, is to be thought of as a kind of sanctuary into which certain proteins may enter, and, so long as they remain behind their wall, be free from the influence of other substances (Macallum).

These considerations are only an entering wedge. We infer a specific chromatin for each race, for every individual, and even for particular cells of the individual. More than this, in its intranuclear state, the chromatin is organized, in all likelihood, permanently, into chromosomes which

[4] For a fuller discussion of the methods, evidence, and conclusions, see the articles by A. B. Macallum in Abderhalden, "Handb. d. Biochem. Arbeitmethoden," and in Ascher-Spiro "Ergebnisse d. Physiol.," VII.

[5] E. G. Conklin, *Journal of Experimental Zoology*, Vol. 12, pp. 1–98.

exhibit symptoms, increasingly serious, of linear differentiation.[6]

If we admit the permeability of the nuclear membrane for chromatin or its immediate forerunners, we can with equal justification attribute the exact character of this membrane to the quantities and qualities of the substances enclosed. Specific permeabilities at once suggest themselves and so, by selective exclusion, any elements not true to one or the other of the types already present within the nucleus may, conceivably, be warded off (Macallum).

Having admitted only specific elements to the nucleus, it becomes our duty to attach them to particular places in specific chromosomes. Here we are, necessarily, thrown on our resources in analogies.

Most suggestive is the behavior of optically active substances in various degrees of dispersion. The common Japanese camphor, dextro-rotatory in alcoholic solution, is also dextral in gaseous as well as solid form. A property therefore which in the highest and intermediate states of dispersal must be attributed to the configuration of individual molecules, is preserved in aggregates of these. This can only result from specific orientation.

Taken alone, this analogy is too simple. It may enable us to form some notion of the terms in which differentiation among the chromosomes is conceivable; but each chromosome, instead of being homogeneous, is, if we can trust ourselves, a system of heterogeneous complexes definitely arranged in space.

Our starting point may again be a relatively simple analog. The hexoses are also systems of heterogeneous complexes definitely arranged in space. While the actual form of the hexose molecule is unknown, the carbon atoms are distributed in a manner conceivable as a linear series in which aldehyde and ketone groups occupy the only positions possible.

Chromosomes, of course, are not large molecules, but aggregates of complexes of these. While the chemical forces determining the specific structure of the individual molecules may be precisely analogous to those which account for the nature of the hexose molecule, aggregation into linear series, in the case of the chromosomes, very likely involves elements not strictly molecular. There is one suggestion, however, that is bodily transferable to the situation presented by the chromosome, namely: factors, in the Mendelian sense, may occupy certain positions because these are the only loci possible.

In this connection, the temporary unions between enzymes and their specific substrates are especially interesting because they depend on the stereo-relations of large complexes of molecules. Conditions, generically similar, may play a determining rôle in the formation of more permanent unions even though these are not chemical. Stereometrically determinable fitness, degrees of fitness, or possibilities of fitness, between various regions of persistent differentiated chromosomes and the newly synthetized elements by the lateral accretion or incorporation of which, these regions grow, enable us to visualize not only the periodic restoration of chromosomes to full size, but even the physical requirements for such phenomena as the single and double cross-over.

THE DIVERSITY OF DESCENDANTS

We can hammer out, on the lines suggested, a provisional interpretation of that constancy in organisms which makes us

[6] This evidence has been brought together conveniently by T. H. Morgan and others, in "The Mechanism of Mendelian Inheritance." The Macmillan Co., 1915.

call them individuals. But no two descendants of either compound or unicellular organisms are strictly alike. Each maintains an individuality of its own different from that of its immediate forerunners. This diversity must also be accounted for.

The differences between parents and offspring are adequately explained by the details of maturation. Why, however, do the units derived from the fertilized egg differ? This question is the inevitable consequence of our inability to consider more than one thing at a time. As yet we have neither reckoned with the differential distribution of cytoplasmic substances nor with the intimate history of the chromosomes during and after division.

Students of embryology are familiar with the distribution of "organ-forming" substances. These have been convincingly traced in a number of eggs (Conklin). The remarkable homologies found in the early development of molluscan and annelidan eggs of various types can be understood only as expressions of the accuracy with which these materials manœuver.

The visibility of an "organ-forming" substance is the merest accident. In the egg or cell from which an individual comes there may be and probably are materials whose accurate but uneven distribution during cleavage has not been noticed. Obviously there may be many occasions on which the cytoplasmic composition is changed during development.

Differential localization of itself indirectly increases the possibilities of further differentiation. With increase in the number of cells come purely physical and mechanical disturbances of equilibrium. In the readjustments that follow, changes of relation, themselves certain to influence the greatest variety of subsequent events, are inevitable. A crisis like gastrulation can not but affect, directly or indirectly, every cell in the system.

I am not forgetting the work of the Drieschian school of experimentalists. They have sinned abundantly in this field for the origin of two or four individuals from an egg whose blastomeres are separated at the appropriate moment by no means demonstrates a harmonious equipotential system. Harmonious it probably is, but equipotentiality is proved by meridional divisions only to those who consider them identical with equatorial or latitudinal cleavages. The production of viable organisms from blastulæ has been misinterpreted in the same way.

Differentiation may also be nuclear in origin. Not only are we unable to exclude the possibility of qualitative and quantitative disparities in ordinary mitosis, but we know positively that differences in nuclei may come about after division. We should recall the somatic cells of *Ascaris* and especially the differential growth of chromosomes.

As Conklin has pointed out[7] the chromatin mass does not necessarily double with each doubling in the number of cleavage cells, since growth is not shared proportionately by all the chromosomes. This fact, which very likely does not apply to the divisions of the sex cells, has been observed in the mitoses of early development, divisions which have been but little studied in detail. Such diminutions in the relative sizes of chromosomes may be accompanied by changes in the chromosomal balance and, through this, bring on changes of equilibrium among cytoplasmic processes. Some chromosomes may, in one respect or another, become ineffective, or in their altered circumstances may have effects qualitatively different from their earlier ones.

[7] *Loc. cit.*

CONCLUSION

From the standpoint here adopted, differentiation is the expression of internal as well as external specificities. It is a cytoplasmic reaction and when it occurs denotes that something is not as it was before. Here as elsewhere, we do not deal with isolated events, but correlative changes with specific antecedents and specific consequences. This linkage of specified happenings persists through the entire life-cycle but in the adult, having few or relatively unimportant morphogenetic results, constitutes the basis for a physiology of maintenance.

In development as well as maintenance, that which constitutes our problem is a harmonic relation among all the processes whose net result makes possible the identification not only of an organism at any stage of life, but also of its ancestors. Such constancy, maintained despite the bewildering complexity and multiplicity of processes, is thinkable only in terms of the most rigid determinism.

The results of destroying portions of an embryo, the restoration of lost parts, heteromorphoses, the development of entire organisms from egg-fragments, grafting, the reorganization of an individual from its disjointed cells, and the fluidity of certain types of behavior, are in no sense counter arguments. All that these show is that the equilibria within which specificity is possible, have a certain range. When the eye-stalk of a crustacean regenerates, not an eye, which it does only under certain circumstances, but an antenna, the antenna is species-true, and when the stump grows an eye, which it does under circumstances of a different sort, but no less specific, the eye is not that of a man or an octopus.

If the developmental history of an individual yields a result from which his ancestry can be inferred, what other proof is needed for the accuracy of all the underlying processes? And what need have we who can think through our problems in materialistic terms for regulatory interference by metaphysical vapors? Far from making these things easier to understand, the table-rappings of the vitalist only withdraw attention from the one basis on which we can hope, at present, for a scientific account of the individual at all.

O. C. Glaser

University of Michigan

THE NECESSITY FOR BIOLOGICAL BASES FOR LEGISLATION AND PRACTISE IN THE FISHERIES INDUSTRIES

It is lack of knowledge of the world he lives in that makes civilized man an actual catastrophe to nature's resources and methods.

In this, as in every new country, earlier generations began a series of stupendous economic blunders of turning into cash every natural asset available, blindly regardless of future necessities. Public assets have been, and in some instances are still, legitimate private booty for those whose imagination may be sufficiently keen to see the gold dollar hidden there. It is only within recent years that evidence has accumulated of the imperative necessity of developing the converse method of solving the economic problems of how best to transform free public goods, *e. g.*, lands, minerals, forests, water power, aquatic life, wild birds and quadrupeds, and scenery, into private property or adequately safeguarded public assets. The problem itself is of huge proportions and extensive in its ramifications. We are only beginning to grasp its fundamentalness and to awaken to the extent of our failure to find the correct solution. We still need a system of education which enables the child, the teacher, the parent, the state and federal legislator better to acquire the fundamental facts and their bearings upon human life and human progress. This alone would have made improbable, if not impossible, the present status where in some respects, in any

event, we are dangerously approaching biological bankruptcy and a condition which if not speedily mended will become more speedily beyond recourse. Even over and beyond such earlier blunders as our methods of distribution and alienation of such national assets as the public agricultural domain, mineral and forest lands, the inconceivable slaughter of the wandering herds of buffalo, elk, antelope and deer, of the clouds of migratory birds on land and the fleets of fish, birds and mammals swimming in the sea, much of the capital of this national wealth has been unwisely turned into cash and reinvested in less stable and permanent form of property, and vast sums put into non-productive and depreciating forms of property. To render the future secure, a considerable portion of the primary proceeds must be again converted back into the original form of investment in nature's laboratory. When obliged to do this we see how difficult and costly, even if not impossible, is the process, and how woefully the capital has shrunk as a result of ignorant and selfish manipulation.

An illustration in a very broad sense is our usual method of dealing with our rivers and streams. The fundamental law of water is that a stream may be used, but in such a manner as not to impair its value to property on the stream below. Yet "civilized" man's first conception of a natural stream is that of a sewer, provided by nature for use as such by municipalities, corporations and individuals. The ocean is falsely regarded as the proper ultimate receptacle of all sorts of material débris of civilization. The next generation will be convinced that vast sums have been unwisely expended in construction of "trunk lines of sewers to the ocean," not to mention the cost to the state of the legislation necessary, or of the prodigious waste of nitrogenous material which is diverted from its immediate useful purpose of nourishing vegetation on land, and the irrevocable loss of other valuable recoverable materials valuable in manufacturing and in the arts.

The immediate effects, however, of the biologically and economically indefensible present methods of disposal of manufacturing and municipal wastes are destruction of fish life and menaces to the public health. I am of the opinion that the annual waste of such materials in the little state of Massachusetts alone results in the loss of at least $3,000,000 each year to the manufacturers and citizens in substances recoverable at a relatively small cost. In addition in that state at least $1,000,000 in potential food value could be annually produced in water now for that purpose made valueless or worse, by pollution. There can be no doubt that the present unsatisfactory conditions in the oyster and fish business in general are due to the false impressions of the sanitary condition of fish and shell fish conveyed to the public mind by the appearance of the shores as a result of our indefensible practises in the disposal of municipal and trade waters.

All this is directly connected with our failure to correlate our practises, whether federal, state, municipal or individual, with the essential basic biological principles. Methods and constructions must ultimately be devised and executed to check this vast waste.

As a nation and as individuals we have failed to recognize and to utilize in adequate measure the necessary and correct biological bases for legislation, and though a beginning has been made in many federal departments, including notably among others the Department of Agriculture and the Bureau of Fisheries, progress elsewhere is still retarded and handicapped by unfortunate precedents, by prevalence of local or merely transient expediencies by amateur "near-statesmen" and by personal opinions forcibly expounded by those who have more enthusiasm or authority than special information or training. In general our state and federal governments are open to severe arraignment for obvious failure to equitably and readily secure, to meet required increased production, the transformation into property of those free goods still held in that type of primitive communism which was possible before the development of an increasing population. With reckless haste and too frequently dangerously close to corrupt methods, we have seen the conversion into private wealth of such public assets as not only the forests, fish, birds and quadru-

peds, the products of land and water, but as well much of the public domain itself, both land and water, the agricultural, timber and mineral lands, the sea shores and the lands under water inside the three-mile limit, etc., directly or by indirection, with the result that we have changed the forms of our investment, destroyed nature's perennial dividend producer, only to find after trial on other lines that we must restore nature's plant and methods, be content to assist nature, and to be satisfied with smaller, though more regular increment. The tendency is to replace, frequently at public expense, what the lethargy of the people has permitted to be destructively turned into private property. We burn our forests, then laboriously replant them. We destroy the native birds, and import foreign species to replace them, and even then are compelled to resort to expensive spraying operations to check insect depredations which under natural conditions would have been controlled in considerable measure by birds. We pollute our sources of drinking water, and then devise costly and sometimes ineffective methods of purification. We poison our rivers, and import food fish from wiser nations, or spend our money for outdoor recreation in more far-sighted communities.

Many of the major abuses have happily now come within the public view and into line for ultimate correction. There remain, however, many minor abuses, similar in that they have arisen from the same causes as have the major ones, viz., the personal acquisitive habits of man. These abuses menace the usefulness, even the existence, of many important public assets because in addition they include an underlying biological fallacy which escaped the notice of the legislators. A biological joker in a legislative bill is sometimes more difficult to deal with than the proverbial "colored gentleman in the pile of ligneous fuel" and is a more certain source of trouble. The most prominent weakness in original legislation dealing with wild life, whether fish, birds or quadrupeds, is the too great emphasis upon "don't." Restrictive legislation, piled Pelion on Ossa, at enormous waste of energy and time, frequently fails to meet expectations, for the reason that it usually ignores the question of increased production. It restricts the demand without increasing the supply. In general, for example, legislation restricting the time (close seasons) and manner of taking, unless closely connected with the breeding habits of such species as can not be readily propagated artificially and thereby made independent of the natural conditions necessary for existence, fails to be effective, in that in many cases they do not increase the supply in proportion to the restriction upon demand. The true method is to increase the annual production by bringing about conditions which augment the number of eggs or young produced and brought to maturity, by minimizing the enemies which prey upon young and adults, by improving the feeding conditions, inducing more rapid growth or improved qualities. Both the terrestrial and aquatic conditions are closely similar and require practically identical treatment. We more quickly, however, detect changing conditions on land and apply the proper remedy without loss of time.

The Pilgrim Fathers had scarcely become fairly settled at Plymouth, where fish were so abundant that it was "enacted by the Court, that six score and 12 fishes shall be accounted to the 100 of all sorts of fishes," before establishing by Article 8 of the laws of 1623, that principle of public rights which has opened at once the wealth of Croesus and given opportunities to the modern Aeolus of legislative bodies, that "fowling, fishing and hunting be free to all inhabitants of this government, provided, that all the orders from time to time made by the General Court for the due regulation of fishing and fowling be observed in place or places wherein special interest and property is justly claimed by the Court or any particular person."

This marks the beginning in this country of the principle of primitive communism which had a basis in genuine altruism, and which beyond doubt then met existing conditions, as seen by those who could not forecast the future and whose mental point of view and horizon was obstructed by unfortunate experiences across the sea.

Present conditions, however, render imperative a modification of this view. Restrictive legislation which is the logical concomitant of this primitive communism, no longer meets the situation. Agriculture has passed through this stage of evolution, into which the fisheries, the wild birds and quadrupeds are now entering, and already species have passed beyond recall as a result of this method of treatment. During a period of scarcity of corn, wheat or potatoes we do not legislate for a "close season" or to limit the quantity to be taken in a day, or to prescribe the methods of taking or marketing, but we use every intelligent device available for stimulating an increased production. Similarly, for example, a close season and a limit upon the day's catch did not prevent the commercial extirpation of the scallop (*Pecten*) in certain localities. The fundamental fact necessary for recognition was that here is a specialized animal which breeds but once in its life time, viz., when one year old; the only adequate remedy possible was to save the young under one year old, permit them to breed, and then in the following autumn and winter market the adults before the end of their natural life.

In the case of the lobster (*Homarus*) the reverse condition obtains. The lobster produces approximately 97 per cent. of the normal total number of eggs after it has reached the size of 12 inches and an age of five to eight years. These breeding lobsters are then beyond the danger from all enemies except man. To prevent an undue diminution of the productive capacity of the lobster as a race the adults which have reached the breeding age must be conserved by uniform laws, if we are to have an annual supply of young produced.

The public and the legislators in relation to the oyster problem have passed the purely biological stages where the methods of increased production were involved and the problem now is to secure legislation for permitting increased production by adequate and well known methods, and to reassure the public upon the sanitary problems involved in the production, distribution and marketing, in order that the market may readily absorb the increasing quantities which can be produced, and thus have the benefit of one of the most important sources of a cheap and valuable food, as yet relatively unexploited.

The crab, shrimp, spiny lobster, are already feeling the effects of over-exploitation, and of neglect to consider proper methods for increasing the required production. The dogfish, destroying more food fish than are marketed, is to-day putting an enormous burden upon the fisherman, and through these upon the fish-consuming public. The existing conditions are unappreciated because unseen. The ocean has not yet become apportioned for purposes of securing increased efficiency of food production. The first evident signs are the world-wide acknowledgment of the desirability of extending the national three-mile limit. It is a significant feature that while the reason given is the increased range of gun fire, the chief opponents are those who wish to carry on commercial fisheries as close as possible to the shores of other nations, or of states. The recent quahaug war in Nantucket Sound, though a minor incident, has its significance. An extensive bed of hard clams, locally called "quahaugs" (*Venus mercenaria*) was discovered just outside the three-mile limit off the mouth of Nantucket Harbor, Mass. The opportunity for "easy money" was quickly and widely apparent and steam dredges from other states speedily "spoiled the market" for the local Nantucket hand-takers. Much bitterness was developed among the fishermen, and on account of the undeveloped facilities for distribution the public failed to secure a just advantage. The future stocking of the surrounding shallows was postponed by destruction of this bed of old spawners, designated as "blunts" in the trade, which yield a low market price compared to the young or "little necks." This vast expense of sandy shallows outside the "three-mile limit" to the edge of the continental plateau is a submarine plain, richer even than the Mississippi Valley in potential capacity for producing human food, but is relatively small when compared with the population which even now depends upon it for its sea-food. With the same degree of support accorded to the Bureau of Fisheries as the agri-

cultural interests have accorded to their department, this territory can be made as productive as the best farming and grazing lands of the nation.

We are but pioneers in this field, and, like our forefathers, may never see the realization of our dreams, but just as they pictured in prophecy the boundless fields of wheat, corn and cotton, so we may picture the development of aquatic farming, where even now hand labor is being replaced by machinery, and by more efficient methods of distribution. The great problem is how best to replace destructive exploitation by constructive methods of increasing production through annual crops.

To this end instruction in economic biology is needed. The federal commissioner, Dr. Smith, has ably pointed out the need of such educational facilities, and until such development can be secured the necessary safeguards for time and capital invested in this work are lacking, and progress must be as of the halt and of the blind.

As a practical matter it is exceedingly difficult for either state or federal departments to draw from a reluctant committee on appropriations money to be used upon projects of which they have no first-hand information and which are exploited by relatively few people. In Massachusetts the problem has resolved itself to a dilemma, whether the fisheries and the shell fisheries shall be maintained from the public treasury and freely open to the public, or whether the fishing rights on the tidal flats shall be leased to individuals and the maintenance and enforcement of the law be provided from the money secured from the leases or licenses and the balance used for reducing the state tax, thus regarding the lands under water and the public fishing rights as a state asset for the benefit of all the people. Consideration of the first proposition clearly leads to the result that if the community plants and cares for the annual crops for the benefit of the fishermen, why should it not do the same for the farmer? And just as the communistic growing of corn and potatoes has proved an economic failure, so must appropriations of money by the town or county for planting clams to be turned into cash by a few people whose interests or necessities impel, be futile unless it is frankly regarded as eleemosynary. The history of nations and of the ages proves that for increased production individual initiative and responsibility is necessary, and the time is not far distant when we must revise our practises and our laws so that all the suitable land below high-water mark may be utilized. No longer will obtain the anomalous condition where, as in Maine, Massachusetts, Rhode Island and other states, oysters may be artificially propagated, but not all other varieties of food and bait mollusks. The several state governments and the federal Bureau of Fisheries are now taking up the plan advocated in 1892, which evoked little response in this country, but which was reprinted in English and German current publications, wherein the writer advocated these practises and pointed out the similarity between the possibilities of agriculture and aquiculture for increasing the yield of food per acre.

It is a deplorable characteristic of human psychology that it is relatively easy to interest people in what is readily seen. The propagation of aquatic forms must overcome the handicap of lack of popular knowledge of the processes involved. It is comparatively simple to secure money to raise black foxes, denatured skunks, or guinea-pigs; but it is still difficult to interest people in commercial utilization of waters for growing fish and shell fish. Our methods of disposal of sewage and waste have militated against this type of investment and development of potentialities. Those who have been accustomed to exploit free goods and still scent opportunities for personal gain at public cost, have learned methods of putting pressure upon public officials and there are relatively few state or federal departments which are not to some extent hampered by some degree of political, personal or local pressure. The situation in Massachusetts is peculiar in that the town is still a dominant community unit, and town and county politicians recognize the advantage of political manipulation of such public assets as

the fisheries, and are loath to promote any development which is likely to curtail their opportunities for personal influence. It is most encouraging to see evidence that the federal departments are each year becoming less dominated by personal and party politics, and that the officials are permitted to follow the facts wherever they may lead, and to apply the possible corrections. So long as this obtains it is the duty of every organization and right-minded individual to support the federal and state authorities in their attempts to administer these assets for the public good.

Many thinking persons view with alarm the increasing tendency to substitute bureaucracy for democracy and state or federal control or regulation made necessary by changing conditions. The danger lies not so much in the form as in the facts. If the bureaus cease to be the real representatives of the demos, and instead of representing the whole people on the firm basis of judicially ascertained facts, their opinions and acts are coerced and warped from the truth by either subjective or objective considerations, so that they no longer represent the federal democratic ideals, but merely localities and special interests, bending to political and transient expediencies, the danger is not only threatening but is already *here*. The remedy is plain. It is in the hands of the people and must be speedily applied.

G. W. FIELD

GRANTS FOR SCIENTIFIC RESEARCH

(*Continued from p. 57*)

CHIEFLY COLLEGIATE INSTITUTIONS

THE following schedule embodies information obtained regarding research funds held chiefly by universities and collegiate institutions. With some marked exceptions these funds are available for use only under the immediate direction of the institution possessing the fund and by those connected with it either as members of the staff of instruction or as holding a fellowship. Funds devoted to agriculture and the mechanic arts, as for example those created by the federal government, it has seemed best to reserve for separate treatment later and more fully than is possible at present. The same is true with regard to funds devoted to astronomical research. Also information has yet to be received regarding marine biological laboratories. Consideration of the appropriations made by Congress for the support of the "Scientific Bureaus" of the United States would seem to come more particularly within the scope of consideration of another sub-committee.

The data already published regarding research funds for scientific purposes which are of general availability throughout the country, and of medical research funds have been gathered from replies to a circular letter issued by the Subcommittee on Research Funds in the spring of 1915, which asked the question:

> Will you be so kind as to inform me whether the institution with which you are connected possesses any research fund and if so what is its amount and for what purposes and under what conditions is it available.

The letter referred to was sent to such institutions as seemed likely to possess funds of this character, the publications "Minerva" and "Who's Who in Science (International)" serving as guides. It was widely distributed among collegiate institutions. Upon the replies received from these last the statements here presented are based.

University of Michigan, Ann Arbor, Mich. Harry Burns Hutchins, President. Three research assistantships have been established to aid researches of designated professors.

University of California, Berkeley, Calif. Benjamin Ide Wheeler, President. Research in general maintained by appropriations from the university funds. There is a considerable endowment for graduate fellowships. Appropriations for scientific publications are made from general funds, in 1916–17, $30,000.

California Museum of Vertebrate Zoology. Supported by annual gift from Miss Annie M. Alexander, of $7,500.

Scripps Institution for Biological Research, located at La Jolla. Wm. E. Ritter, Scientific Director. Supported by annual gift of $10,500 from Miss Ellen B. Scripps for which an endowment is pledged, and annual appropriation of $12,500 from state.

Massachusetts Institute of Technology, Boston, Mass. Richard C. Maclaurin, President.

Ellen H. Richards Fund. $16,250. For research in chemistry.

Charlotte B. Richardson Fund. $33,379. For research in industrial chemistry.

Whitney Fund. $26,890. For research in seismology.

Samuel Cabot Fund. $55,190. For equipment in industrial chemistry.

For research in sanitary science, the institute has received annually for many years a gift of $5,000–$6,000.

For researches in electrical engineering a gift from the American Telephone & Telegraph Co. per annum for a period of five years from 1913, $15,000.

The institute makes regularly an appropriation from its general funds for research in physical chemistry.

Harvard University, Cambridge, Mass. A. Lawrence Lowell, President.

Jefferson Physical Laboratory. Income from Coolidge Fund (1914–15), $2,700. Joseph Lovering Fund for physical research, $7,720. Ernest B. Dane Fund, available in part for research in physics, $50,000.

Department of Chemistry. Income from C. M. Warren Fund (1913–14). $334.

Gray Herbarium. Remainder of income from endowment of $300,000 not needed to care for collections is chiefly devoted to furthering research.

Peabody Museum. Peabody Foundation Fund. $45,000. Income used for collection and research in archeology and ethnology with special reference to the aboriginal American races.

Huntington-Frothingham-Wolcott Fund. $20,000. Income devoted to archeological and ethnological research and exploration and publication.

Henry C. Warren Fund. $10,000. For carrying on exploration. Principal and interest to be used at the discretion of the corporation.

Mary Hemenway Fund for Archeology. $45,000. Income available for original research in archeology.

The following research fellowships are awarded annually in the Peabody Museum.

Thaw Fellowship. $1,140 per annum. For "work and research relating to the Indian race of America or other ethnological and archeological investigations."

Hemenway Fellowship. $575 per annum. For the study of American archeology and ethnology.

Winthrop Scholarship. $275 per annum. For the study of archeology and ethnology.

Fellowship in Central American Archeology. $600 per annum. For the study of this subject.

Harvard Fellowship in the International School of American archeology and ethnology, Mexico City. $600 per annum.

Department of Geology. Shaler Memorial Fund. $30,367. For original research in geology in the broadest sense, including paleontology, mineralogy, economic geology, etc. The persons nominated for such research are not necessarily officers or students of Harvard University.

Secondary Enrichment Fund. $50,000. Subscribed mainly by American Copper Companies for investigation regarding secondary enrichment of copper ores in the United States, Alaska and Mexico.

Frederick Sheldon Fund for Traveling Fellowships. $396,157. Applicable to the aid of students of Harvard University in further study or investigation "either in this country—outside Harvard University—or abroad."

University of Iowa, Iowa City, Iowa. Carl E. Seashore, Dean. The University possesses a fund of $16,000, about half of the income from which may be used in emergency for research.

University of Wisconsin, Madison, Wis. C. R. Van Hise, President. Usual appropriation in college of engineering for specific research work $5,000 per annum.

Wesleyan University, Middletown, Conn. Wm. Arnold Shanklin, President.

Crawford Memorial Fund. $5,000. Available for purchase of apparatus and promotion of research in physics.

Amos Jay Given Biological Fund. $25,000. Available for maintenance of the department of biology and for the promotion of research in that subject.

University of Minnesota, Minneapolis, Minn. George E. Vincent, President. Funds for research and publication, $10,000 annually, divided as exigencies may dictate.

McGill University, Montreal, Canada. William Peterson, Principal.

Research Fellowships in Mining. $10,000.

Research Fund in Metallurgy. $7,500.

Research work chiefly carried on by annual appropriation.

Rutgers College, New Brunswick, N. J. W. H. S. Demarest, President. Agricultural Research

Fellowships of limited duration have been established as follows:

Sulphur Research Fellowship in plant pathology. $1,000 per annum for three years; expires 1916. Established by the Union Sulphur Co., of N. Y.

Pulverized Limestone Research Fellowship. $600 per annum for three years; expires 1917. Established by Thomas A. Edison.

Potash Research Fellowship. $1,000 per annum for three years; expires 1917. Established by German Kali Works.

Sodium Nitrate Research Fellowship. $700 approximately per annum for three years; expires 1917. Established by the Nitrate Propaganda.

The Amo-Phos Research Fellowship. $600 per annum for three years; expires 1918. Established by the American Cyanamide Co., Buffalo.

The Soy Bean Research Fellowship. $600 per annum for three years; expires 1918. Established by the Murphy Varnish Co., Newark.

New Jersey Zinc Company Fellowship. $1,000 per annum for three years; expires 1919.

Yale University, New Haven, Conn. Arthur T. Hadley, President.

Dana Fund. $24,000 (ultimately). Available for original investigation in geology.

Hadley University Fund. $1,030. Available for research in general.

Elias Loomis University Fund. $314,000. Available for payment of salaries of astronomical observers and the cost of reducing and publishing observations.

Seessel University Fellowship Fund. $43,500. Available for original research in biological studies.

Hepsa Ely Silliman Fund. $85,000. Applicable to a certain extent for scientific research.

Sloane University Fund. $50,000. Applicable to the payment of research assistants in the Sloane Laboratory of Physics.

Sloane Laboratory Fund. $75,000. Income used for the promotion of research and study in physics.

Thomas C. Sloane Fund. $75,000. Available for the study of physics in the Sloane Physical Laboratory.

Russell H. Chittenden Fund. $4,000. Available for research in physiological chemistry.

American Museum of Natural History, New York. Henry F. Osborn, President.

Jesup Fund. $1,000,000. To promote research, exploration and publication.

Morris K. Jesup Fund. $5,000,000. Bequest for purposes similar to preceding fund. Not yet available.

Columbia University, New York, N. Y. Nicholas Murray Butler, President.

Adams Fund. $50,000. Available for the support of a research fellow in physical science and for the publication of the results of his investigations.

Dyckman Fund. $10,000. Available for research in biology.

Peters Fund for Engineering Research. $50,000. Available for research in the department of civil engineering.

Throop College of Technology, Pasadena, Calif. James A. B. Scherer, President. $10,000 per annum guaranteed for maintenance of a department of chemical research. $10,000 given for equipment of same.

Princeton University, Princeton, N. J. John G. Hibben, President. Departmental Fund yielding about $9,000 per annum. Available in part for research.

Brown University, Providence, R. I. William H. P. Faunce, President. Research Fellowships have been founded as follows:

Grand Army of the Republic Fellowships, $10,000. Applicable to advanced liberal study.

Arnold Biological Fellowships. $10,000. Applicable to biological research.

Morgan Edwards Fellowship. $10,000. Applicable to original research in any department of knowledge.

University of Utah, Salt Lake City, Utah. J. T. Kingsbury, President. Fund for research in School of Mines. $7,500. Also some departmental funds for research.

University of Toronto, Toronto, Ontario. Robert Falconer, President. Exhibition of 1857 Scholarship for Scientific Research, awarded biennially £150.

Rensselaer Polytechnic Institute, Troy, N. Y. Palmer C. Ricketts, Director. Louis E. Laflin Research Fund. $10,000. Appropriations for research also made from general funds.

University of Illinois, Urbana, Ill. Edmund J. James, President. Trustees assign amount of general appropriation from legislature which shall be devoted to research. Graduate School appropriation about $60,000 per annum.

Clark University, Worcester, Mass. G. Stanley Hall, President. Smith-Battles Fund for Psychological Research. $5,000.

It will be obvious from the preceding data that the number of university research funds and especially of permanent endowments is small, and that several of our universities which are distinguished for the amount and the excellence of the scientific papers emanating from them do not possess such funds, so that by far the greater amount of scientific research which is carried on in this country is sustained by special appropriations. And, furthermore, much of the research work pursued in institutions possessing research funds is also sustained by such budget and special appropriations.

In many of the replies received by the committee attention is called to the fact that while there is no endowment for research yet appropriations sometimes large in amount are regularly made for the purpose. The following abstracts of certain of these replies, although lying somewhat outside of the immediate scope of the inquiry made, will be of interest.

Ohio State University: several graduate fellowships established requiring research work. Johns Hopkins University: besides appropriations for research made in budget for each department, income of various funds is drawn upon for purposes of research. Bowdoin College: maintains a table at the Marine Biological Laboratory at Woods Hole. University of Chicago: special appropriations for research made from time to time from the general funds of the university. Field Museum of Natural History: appropriations for surveys, investigation, etc., made from general fund. University of North Dakota: $700 annually from departmental appropriations used for research. Denison University: annual appropriation, $500, made for publication of research work done in the university. Dartmouth College: besides general departmental appropriation in budget, special appropriations for research are made from time to time. Drexel Institute: pays in part fees for professors engaged in investigation. Cornell University: besides appropriations in budget, the university sometimes releases a professor from teaching in order to carry on research. University of Kansas: $8,000 available for fellowships. Mellon Institute of Industrial Research: expenses of researches met by private subscription. Leland Stanford Junior University: appropriations for research made from budget. Pennsylvania State College School of Engineering: expended for research, 1915–16, $1,549. Rose Polytechnic Institute: research work provided for by special appropriation. University of Arizona: will probably receive $5,000 from the state for research in mining. Tufts College: department of biology maintains a room at Harpswell Laboratory. Wellesley College: occasionally an appropriation is made for research carried on by a professor on leave of absence. University of Manitoba: sum of $1,000 has been collected for research in physiology. Worcester Polytechnic Institute: part of annual appropriation spent for research.

The data which the committee has gathered regarding research funds, while fulfilling the ends which it was intended to reach, can not furnish any definite idea of the real amount expended annually in this country in aid of the progress of scientific research. Such information is very desirable, but to obtain it will require a much more extended inquiry than the present one.

While much care has been exercised in the compilation of the foregoing matter, there will doubtless be found errors both of omission and of statement. The undersigned will be glad to receive corrections of such and to insert them later.

Charles R. Cross,
Chairman

KARL SCHWARZSCHILD

The American friends of Professor Schwarzschild hoped that the report of his death was a mistake, but since its confirmation by private letters from Germany, they have felt a great sense of sorrow and loss, not only to science, but to themselves personally. Schwarzschild made a visit to this country in 1910, attending the meeting of the Astronomical and Astrophysical Society of America at the Harvard College Observatory and the meeting of the Solar Union at Pasadena. This visit gave an opportunity for closer acquaintance which ripened into personal friendship, and increased our admiration for the man as well as for the astronomer.

Schwarzschild was born at Frankfort-on-the Main, 1873, October 9. His first astronomical work was done as assistant at the von Kuffner Observatory in Vienna from 1896 to 1899. This work appeared in volume five of the pub-

lications of the von Kuffner Observatory entitled *B*, "Die Bestimmung von Sternhelligkeiten aus Extrafocalen Photographischen Aufnahmen," *C*, "Beiträge zur Photographischen Photometrie der Gestirne." This was pioneer work in the use of extrafocal images, in that it was brought to a successful outcome and applied to various regions of the sky. The Director de Ball published a very appreciative description of Schwarzschild's work in the *Bulletin Astronomique* for 1905.

From 1899 to 1901 Schwarzschild was "privatdocent" at the University in Munich, and in 1901 was called to the University of Göttingen as director of the observatory and professor of astronomy. He held this position for eight years, which were rich in astronomical results, both theoretical and practical. The theoretical work appeared in parts 9–11 of the "Astronomische Mittheilungen der Königlichen Sternwarte zu Göttingen." Perhaps the most interesting part relates to the improvement of the reflecting telescope by a combination of curves of the two mirrors which would give a field as flat as the refractor used for the "Astrographic Chart."

The practical part of the work at Göttingen included an improvement on the method of extra-focal images which had been used at Vienna. This consisted in giving a motion to the plate during the exposure, so that the image (itself in focus) was built up into a square area sufficiently large to be measured as an extra-focal image. This attachment was called the "Schraffierkassette," and there resulted from its use the "Göttingen Aktinometrie," which covered the zone 0° to +20° declination. This appeared as part fourteen of the Göttingen publications, and gave the photographic magnitudes of 3,522 stars, also the visual magnitudes as measured at Potsdam by Müller and Kempf.

About this time Schwarzschild suggested the use of the difference between the photographic and the visual magnitudes as a measure of the color of the stars. He suggested the term "Farbentönung" (color-index), and gave this quantity for each of the stars in the "Aktinometrie." He was also one of the first to apply the color-index to the determination of the temperature of the stars.

During his stay at Göttingen he also devised instruments for determining geographical positions in the navigation of airships. The sextant as modified for this purpose was described in "Zeitschrift für Flugtechnik und Motorluftschiffahrt," 1913.

Schwarzschild was called to succeed Vogel as director of the Astrophysical Observatory at Potsdam in 1909. He brought to this trying position a talent exceptionally ripened for a man only thirty-six years of age, and he filled the position with distinguished success. During his term the astrophysical work at Potsdam was carried forward in a way worthy of its first director and his brilliant staff, and the list of publications bears witness not only to the work of the different astronomers, but also to Schwarzschild's ability as a director. Among Schwarzschild's theoretical contributions during this period may be mentioned his work on the distribution of stars in space.

The remarkable range included in Schwarzschild's work, from the improvement in the sextant to the distribution of stars in space, showed that he combined theoretical and practical ability in an unusual degree, thus fitting him especially for the directorship of a great astrophysical observatory.

Schwarzschild's personality was especially pleasing. He was lacking entirely in that stiff formality which renders so many men in high positions unapproachable. He had a great capacity for friendships, and his admiration for Dyson, the English Astronomer Royal, was very pronounced. What could be finer than the simple statement which he made in regard to Dyson, "We nearly always think alike." Schwarzschild's disposition was not in the least jealous. As an example of this may be mentioned his suggestion to the International Committee, that the magnitudes of the Harvard System should be taken as the international standards, and that the other systems should be reduced to this by the application of suitable corrections.

Schwarzschild was happy in his domestic relations and his home was always open to his

friends without any formality. It will be extremely difficult to fill his place and the sense of loss on account of his early death will be very widespread. J. A. PARKHURST

YERKES OBSERVATORY

REPORT ON INFANTILE PARALYSIS

THE conference committee of pathologists which met in New York City on the invitation of the city authorities has made the following report to Dr. Haven Emerson, commissioner of health.

Having been called to New York at your suggestion, and for the purpose of consulting with you concerning the practical measures employed in dealing with the present epidemic of poliomyelitis, we offer the following statement.

We have spent two days in studying the situation and investigating prevailing conditions.

On Thursday morning we went over with you the history of the origin and spread of the epidemic of this year. We made a careful study of your maps and diagrams showing the number and distribution of cases in the different boroughs of the city. This was followed by a discussion of the methods that have been employed, both here and elsewhere, in attempts to control the spread of the disease.

In the afternoon of the same day we visited Willard Parker Hospital and made a careful inspection of the treatment and care given by the city to the children afflicted with this disease.

Thursday evening we had a discussion concerning the methods being employed and the possibility of making these more efficient.

On Friday morning we visited cases quarantined in their own homes, and in this way were able to compare the hospital care with the home care of the sick. We also made a survey of certain crowded infected districts, and, with a diagnostician, we visited certain homes in which cases have been recently reported.

Friday afternoon we gave to a more formal discussion and the suggestion of definite recommendations.

We have given special attention to the methods now employed by you and your department, and we approve of the measures you have taken.

The weight of opinion favors the view that infantile paralysis is mainly spread through personal contact, and measures have been directed chiefly from this point of view. Cognizance, however, has been given to additional methods of transmission, among which is the bite of insects. For sanitary purposes it is proper to consider that this disease is transmissible directly from the sick to susceptible persons, or indirectly from the sick through carriers.

Even with our incomplete knowledge of the dissemination of the disease, it is evident that, in seeking to abate the epidemic, stress must be especially laid upon two things, as is now being done:

1. The early recognition and notification of the disease, and

2. The immediate isolation of patients and cases of suspicious illness.

Furthermore, on account of incomplete knowledge concerning the disease, measures known to be effective in checking the spread of other infections should be applied and these are, particularly, personal hygiene, cleanliness of person and surroundings, and care of food, which should be thoroughly cooked.

In order to secure the earliest possible recognition and notification of cases and their prompt isolation, we wish to direct particular attention to the appeals that have been made by the department to the physicians of the city and to the public generally that they cooperate with the department in all these measures.

We strongly recommend that you inaugurate a house-to-house inspection of as large a part of the city as is practicable, twice a week, for the purpose of education and of securing the early recognition, notification and isolation of the disease.

We are of the opinion that satisfactory isolation is secured only in hospitals. Moreover, not only is more thorough protection secured for the public by the hospitalization of patients, but it is also better for the individual patient.

There is still much to be learned concerning the period of incubation, accurate methods of early diagnosis in non-paralytic cases, modes of transmission and the length of time persons continue to carry the infection, and, in view of these factors, a scientifically adequate method of control is impossible at the present time.

The committee recommends the closest co-operation possible among the different laboratories and investigators that may enter upon investigation of problems connected with epidemic poliomyelitis.

The committee would suggest the following problems as especially desirable for investigation at this time.

1. Methods of culture of the virus of poliomyelitis, with especial reference to corroboration of previous work, to simplification of methods, and to the distribution of the virus in the body of patients.

2. The immunologic reactions of patients, supposed carriers of the virus, and others.

3. The virulence for animals, of the crude virus, in order to determine if possible whether there are any differences in the virus causing outbreaks in different parts of the country as well as to discover, perchance, more susceptible animals for experimental purposes than are now available.

4. The microscopic study of the secretions of the nose and throat and of the intestinal contents of patients suffering from poliomyelitis, persons who have come in close contact with such patients, and others.

5. The transmission of the disease by insects and domestic animals and other possible modes of transmission.

6. The study of practical methods of disinfection.

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM H. WELCH sailed from New York on August 6 for England to make studies in connection with the organization of the school of hygiene and public health established by the Rockefeller Foundation at the Johns Hopkins University. Dr. Welch will also study, as president of the National Academy of Sciences, the manner in which England has been organized in scientific lines for the war. He is accompanied by Dr. George Ellery Hale, chairman of the committee of the academy on scientific organization.

THE Cartwright Lectures for 1916 of the Association of the Alumni of the College of Physicians and Surgeons, Columbia University, will be given by Dr. Richard M. Pearce, professor of research medicine, University of Pennsylvania, on October 24 and 25. Professor Pearce's subject will be: "The Spleen in its relation to blood destruction and regeneration."

DR. J. HOWARD BEARD, Urbana, has been appointed health officer of the University of Illinois.

DR. GUSTAVUS MANN, until last year professor of physiology in Tulane University, has been appointed consulting chemist for the Freeport Oil Company of Texas.

DR. DONALD B. ARMSTRONG has resigned as director of the department of social welfare of the New York Association for Improving the Condition of the Poor, to become assistant secretary and director of the community tuberculosis experiment of the National Association for the Study and Prevention of Tuberculosis.

DR. HERBERT J. SPINDEN, of the American Museum of Natural History, has been given charge of the archeological survey of Porto Rico undertaken by the New York Academy of Sciences, and has been in the field. In the early part of the season he visited Venezuela for a preliminary archeological reconnaissance.

PROFESSOR A. L. KROEBER, of the University of California, has returned to Zuñi for further investigation of their social and ceremonial organization.

DR. JAMES J. MILLS, instructor of ophthalmology at the Johns Hopkins Medical School, has sailed for France, where at Biarritz he will assist in the treatment of injuries to the eyes of the soldiers.

THE Antarctic relief ship *Discovery*, which has been placed at the disposal of the British Admiralty for use in the effort to rescue the

marooned men of Sir Ernest Shackleton's expedition on Elephant Island, sailed from Plymouth Sound on August 10, for Port Stanley, Falkland Islands. Sir Ernest will embark at that port in another effort to reach Elephant Island.

M. Henry Nocq has been commissioned to prepare a portrait plaque of the French archeologist and anthropologist, M. Joseph Déchelette, who has been killed in the war. Subscriptions may be sent to M. le Comte O. Costa de Beauregard, Sainte-Foy, par Longueville (Seine-Inférieure). Those sending a subscription of 10 francs are entitled to a replica of the plaque in bronze, those giving 50 francs to one in silver.

Dr. John Benjamin Murphy, the distinguished surgeon, professor of surgery in Northwestern University, died on August 11, aged fifty-nine years.

Dr. Bushell Anningson, lecturer in modical jurisprudence in the University of Cambridge since 1884, has died at the age of seventy-eight years.

Edgar Albert Smith, an authority on conchology, from 1867 to his retirement in 1913 on the scientific staff of the British Museum, died on July 22, aged sixty-nine years.

The death is announced of Dr. R. C. Delgado, of Havana, member of the Cuban Board of Health and secretary of the Havana Academy of Sciences.

The Swedish government has decided to postpone until July 1, 1917, the distribution of the Nobel prizes in physics, chemistry, medicine and literature.

The Paris Academy of Medicine, following the precedents of 1914 and 1915, has decided not to suspend its sittings this year. It will continue to meet during the months of August and September for the discussion of questions relating to public health and national defence.

Mr. Richard T. Crane, in a telegram to Mayor Mitchel, of New York, announces a gift of $25,000 to the individual who may offer the best cure for infantile paralysis, or the best solution to that problem, within a year.

The Senate Public Health Committee, on July 28, voted to report favorably a proposed appropriation of $2,000,000 to be spent in the care of indigent sufferers from tuberculosis. The object of the appropriation is to relieve the states of the care of invalids who leave their homes in search of health and then become charges on other communities.

The United States Public Health Service has inaugurated a campaign for the relief of sufferers from hay-fever. The service will endeavor to have state legislatures enact laws to provide means for fighting weeds which are known to provoke the disease. It is said that 2 per cent. of the people of the United States are sufferers from hay-fever.

Nature quotes from the June number of the *Bul. Imp. Acad. Sci.*, Petrograd, the statement of plans to establish a biological station on Lake Baikal. The largest of the fresh-water lakes of Europe and Asia, and said to be the deepest in the world, it possesses a fauna in many respects unique. Some of its fishes are found nowhere else, and some live at a greater depth than any other fresh-water fishes. Among them are very ancient forms, and, according to some investigators, vestiges of the Upper Tertiary and subtropical fauna of Siberia and, possibly, of central Asia. Though Lake Baikal has long since attracted the attention of Russian zoologists, much remains to be done, and it is felt that private research, valuable as its achievements have been, should be supplemented by a fully equipped biological station, which alone can cope with the problems involved in a thorough and systematic investigation. The subject has been mooted for some time past in Russian scientific circles and is now brought within measurable distance of realization by a donation of £1,600 received from a Siberian gentleman, Mr. A. Vtorov, and the academy has appointed a commission to take immediate steps to give concrete form to a project destined to be of great importance for biological science.

PRELIMINARY steps have been taken by the War Department toward the formation of a Reserve Corps of Engineers for the army, as provided by the National Defense Act of June 3 last. By direction of the chief of engineers letters were sent to-day by Lieutenant Colonel E. Eveleth Winslow, of the Army Engineer Corps, to all the district engineer officers of the army throughout the country, paving the way for the creation of these new reserve corps, which will be composed of officers to be commissioned from among the engineers of the country and of an enlisted reserve corps of engineers. The plan for the formation of the new Reserve Corps is set forth in Lieutenant Colonel Winslow's letter as follows: "The importance of engineers in time of war is now universally recognized, and during the past few months steps have been taken to arouse the interest of the engineering profession in the national defense. Congress has now provided a means by which the civil engineers can more fully prepare themselves for that highest duty of citizens—the defense of our country. An engineer section of officers and enlisted reserve corps has been authorized, and in the opinion of the chief of engineers there is for the officers of the Corps of Engineers no more important duty than their active assistance in making a success of the new corps. All the engineers in the country should be informed of the existence of this new corps and those possessing the necessary qualifications should be enrolled as its members. A close cooperation between our engineer officers and the civilian engineers is therefore necessary, and fortunately the first steps in such cooperation have been already taken by the action of some of the most important of the engineering societies in indorsing the campaign for preparedness and in urging upon Congress the passage of the Officers' Reserve Corps law.

THE Senate Committee on Public Health and National Quarantine has reported favorably the bill to promote the efficiency of the United States Public Health Service. The bill has already passed the House of Representatives. The bill limits, according to the *Journal* of the American Medical Association, the appointment of the surgeon-general of the Public Health Service to commissioned officers in the service, not lower in grade than surgeon, and require that the surgeon-general at the expiration of his four-year term of office be carried as an extra number in the grade of assistant surgeon-general, unless he be reappointed. As an inducement to physicians to enter the service, the bill provides for the promotion of assistant surgeons to the next higher grade after three years' service, instead of after four years as at present. The chiefs of the bureaus of zoology, pharmacology and chemistry in the hygienic laboratory, are to be commissioned by the president, by and with the advice and consent of the Senate, as professors of zoology, pharmacology and chemistry, respectively, and are to be entitled to leaves of absence as now provided by law for commissioned medical officers. Provision is made for the appointment of five additional professors, qualified for special work in sanitary engineering, epidemiology, pathology, anatomy, bacteriology, housing, or other matters that relate to the propagation and spread of disease. Men of this class, the committee's report says, often do not have medical degrees, and under the present system of commissioned service only doctors of medicine are provided for; and the bill will remove this defect and make places for men who are specially trained in these highly technical fields, but who are not graduates in medicine.

UNIVERSITY AND EDUCATIONAL NEWS

LAFAYETTE COLLEGE is the residuary legatee of Albert N. Seip, of Washington, D. C., a member of the class of 1862. It is said that the college will ultimately receive not less than $250,000.

DR. ROBERT BENNETT BEAN, now professor of gross anatomy at Tulane University, has been appointed professor of anatomy at the University of Virginia, to take charge of the courses in gross anatomy and neurology formerly given by the late Dr. Richard H. Whitehead.

Dr. R. M. Strong has resigned the chair of anatomy at the University of Mississippi to accept the position of associate professor of anatomy in the medical school of Vanderbilt University, Nashville, Tenn.

The following appointments to the faculty of the University and Bellevue Hospital Medical College have been announced: Dr. William C. Lusk, professor of surgery; Dr. Joseph B. Bissell, Dr. Thomas A. Smith, and Dr. Arthur M. Wright, clinical professors of surgery; Dr. W. Howard Barber, chief of clinic, department of surgery; Dr. George Francis Cahill, instructor in surgery; Dr. Theodore J. Abbott, clinical professor of medicine; Dr. Benjamin M. Levine, clinical professor of cancer research; Dr. Charles Krumwiede, Jr., assistant professor of bacteriology and hygiene; Miss Mary Smeeton, instructor in bacteriology.

Promotions in the philosophical and engineering faculties of the Johns Hopkins University has been made as follows: Knight Dunlap, professor of experimental psychology; Joseph C. W. Frazer, professor of analytical chemistry; E. Emmet Reid, professor of organic chemistry; Grandville R. Jones, associate professor of civil engineering; Paul B. Davis, associate in chemistry; William B. Kouwenhoven, associate in electrical engineering.

DISCUSSION AND CORRESPONDENCE

CULTURE MEDIA FOR PARAMECIA AND EUGLENA

A communication to this journal by J. B. Parker, entitled "A Method of Maintaining a Supply of Protozoa for Laboratory Use,"[1] brought to my mind a culture medium which I used at the University of Chicago for a few years and found thoroughly reliable. The method was given to me by one of my assistants at the time, Mr. John G. Sinclair, who according to my recollection had obtained it from Dr. A. W. Peters, of the University of Illinois.

Enough wheat to make about one half gram per liter of the culture solution is boiled in a small quantity of water for a few minutes. (The original method as given to me called for cracked wheat, but I obtained good results with whole wheat.) The boiled wheat is then placed in tap water in the ratio indicated above, and the solution is inoculated either from some culture of paramecia already on hand or with pond water. In most cases, I used water taken from the immediate vicinity of submerged pond vegetation. It was my custom to use large battery jars for the culture media, which were placed with glass covers on a table in the room where the paramecia were to be used. In the course of a week or so, depending upon the room temperature, I was always able to obtain an abundance of large paramecia.

A method for *Euglena* was also given to me, but I never used it, having no occasion to need this protozoan. I presume the method is equally good. One half gram of rice per liter of culture solution is washed thoroughly and drained. The washed rice is then boiled for about five minutes and put into tap water. After inoculation, the solution is placed where it may obtain direct sunlight.

The directions also state that it is advisable to add about one fourth gram of boiled grain (rice or wheat according to the culture) per liter of the medium, every three weeks and also just before use by a class begins. Furthermore, it is desirable to stir the solution every few days for an oxygen supply.

R. M. Strong

SEVERE RESTRICTIONS TO NORMAL GEOGRAPHIC CYCLE

The formulation of the conception that there is a distinct cycle of corrasive development through which all land-forms must pass is now generally recognized to be one of the first half-dozen brilliant achievements in geologic science of the century just closed. Like many broad generalizations, this one is, upon critical submission to quantitative measurement, found to be too sweeping in its character. Close inspection soon discovers that there are grave complications in the normal scheme. Already the latter has to be especially adapted to fit, on the one hand, condi-

[1] Science, November 19, 1915, p. 727.

tions of glacial climate, and, on the other hand, conditions of arid climate.

Limitations to the normal geographic cycle are even more severe than these bare statements intimate. If the United States, for instance, be divided into three north and south belts of subequal size one of the divisional lines coincides with the course of the Mississippi River; and the other with the line of the Rocky Mountain front. The belts are each approximately one thousand miles in width.

In the easternmost of these belts the forces of normal landscape sculpturing are most active. The rivers at the present time are wearing down the mountains and hills towards base-level about as rapidly as is done anywhere else on the face of the globe, and about as fast as it is ever done.

In the central belt, the tract lying between the Great River and the Rocky cordillera, the streams traversing the region are far from doing normal corrasive work or of producing net results. Between the Canadian and Mexican boundaries, a distance of more than 2,000 miles, only five streams leave the Rocky Mountain front, and four of these are quite inconsiderable. They can have relatively little influence in the effort to base-level so vast a region as the Great Plains. Dust and sands from western deserts are constantly exported to this region. In fact, lying on the leeward side of the arid lands the Great Plains country is a chief area of wind-laid depositions. The continental deposits over much of the region are more than 1,000 feet thick, a fact amply attesting the prodigious extent and the unusual rapidity of their formation. This circumstance alone explains the excessively slow rate of continental denudation which the recent government stream-measurements of the Mississippi River give. The normal geographic cycle does not obtain in this region.

In the westernmost belt the general lowering and leveling effects of rivers are inappreciable. Water-work is reduced to its lowest terms. Wind is the mastering erosive agency. The geographic cycle has for its dominant element wind-scour instead of stream-corrasion.

The idea has a still broader bearing. It has world-wide application. According to the late Sir John Murray more than one fifth of the entire land surface of the globe is desert. Another one fifth and more is little affected by normal river corrasion. Still another one fifth of the land surface is, or at least was until very recent geologic times, as truly desert as is the Sahara to-day. Of all the world's land area, therefore, fully two thirds are not subject to normal stream-work; and the normal geographic cycle is without verity.

CHARLES KEYES

UGO SCHIFF

IN SCIENCE, June 30, 1916, page 922, Professor Wm. McPherson, in his obituary notice of Ugo Schiff, says:

> This recalls the fact also that Professor Baeyer's laboratory at Munich did not include any laboratory devoted to physical chemistry until 1913, when a small room was fitted up for this work.

Professor McPherson is mistaken. During a number of years before and after 1887, Krüss gave, in Baeyer's laboratory, courses of lectures and laboratory work in physical chemistry. The complete courses ran through several semesters and the experimental exercises were given in a room specially fitted. They included density determinations of solids, liquids and gases, by various methods, cryoscopic molecular weights, spectroscopic work (emission and absorption), optical rotation, etc. Probably no better courses were given anywhere, at that time, outside Ostwald's laboratory. It may well be that Krüss's premature death caused the courses to be discontinued.

J. BISHOP TINGLE
McMASTER UNIVERSITY,
TORONTO, CANADA.

SCIENTIFIC BOOKS

The Origin of the Earth. By THOMAS CHROWDER CHAMBERLIN, head of the Department of Geology, The University of Chicago. The University of Chicago Press, 1916. Pp. x + 271. (The University of Chicago Science Series.)

This book, by the distinguished author of the planetesimal hypothesis, is one which has

long been desired by geologists as well as other scientists. The method of treatment conforms to that followed by the University of Chicago Science Series. This requires that the subject shall be presented "in as summary a manner and with as little technical detail as is consistent with sound method. These volumes will be written not only for the specialist, but for the educated layman."

The previous publications on the planetesimal hypothesis and its relations to the origin of the earth are found in articles chiefly by Chamberlin in the *Journal of Geology,* chiefly by Moulton in the *Astro-Physical Journal* and by various collaborators, mostly in publications of the Carnegie Institution; but only the specialist has pursued all of this more or less technical literature to its lairs. In addition, Moulton has given some account of the astronomic aspects of the hypothesis in his text-book of astronomy and Chamberlin and Salisbury in 1906 have given considerable space to the subject in their "Geology," especially the first eighty pages of Volume II. These are works which are not readily accessible to the educated layman. Furthermore, the present volume by going straight to its end and omitting technicalities brings the essential framework of the hypothesis into better relief and perspective than is the case in Chamberlin and Salisbury's "Geology." Published ten years after the latter, it furthermore takes advantage of the research of a later decade. There is added also an essentially new chapter on "The Juvenile Shaping of the Earth."

The form of presentation is very readable and attractive. It follows largely the intellectual trail which led the author, as he says, a specialist in glacial geology, "across the pass that leads from the land of rocks into the realm of cosmogonic bogs and fens. Its mists were already gathering over the path ahead. Strangely enough, the cold trail of the ice invasion had led by this long and devious path into the nebulous field of genesis."

All older views of the origin of the earth had grown up around the idea that the matter which constitutes the planets was a residuum left from the primal gathering in of the solar nebula. This process had been given concrete form in the nebular hypothesis of Laplace. But an examination of the stubborn facts expressed in the structure and motions of the solar system brought out dynamical inconsistencies with the terms of the nebular hypothesis. Modified forms of that hypothesis could not overcome the objections. Therefore Chamberlin was led to build up an hypothesis of earth origin from a totally different beginning. He postulated an ancestral sun already condensed and sought to derive the planetary matter and planetary energies of motion from the expulsive forces set up by the close approach and passage of another star. The result was the development of a great swarm of larger and smaller particles revolving independently but nearly in one plane in elliptic orbits about the sun. This is the basal foundation of the planetesimal hypothesis. In these respects it is in direct opposition to the Laplacian hypothesis and in considerable opposition to the meteoritic modifications from that hypothesis.

The subject is vast and the evidence on many aspects is somewhat vague. A variety of subhypotheses could be raised for comparison with those which are linked together by the author to make a consistent whole. This would lead so far afield, however, that this review will be held rather closely to a presentation of the vital points in each chapter, thus placing stress on a summary of the arguments of the ten chapters rather than on an analysis of their bases upon which they rest.

The first chapter is on the Gaseous Theory of Earth-Genesis in the Light of the Kinetic Theory of Gases. The spheroids of gravitational control of the planets are considered, the minimum radius of the earth's being about 1,000,000 kilometers. The relation of the mass of the planet to its power to retain an atmosphere is the next thesis. Beyond that zone of atmosphere which is dense enough to obey the kinetic law of gases, but within the outer limits of the spheroid of control, must lie an ultra-atmosphere divided into two zones. The lower of these is characterized by fairly free molecules driven upward from below by the impacts

of other molecules and curving back again under the pull of the earth's gravitation into the denser atmosphere. The action is like that of particles of water splashing back in a fountain or like the spray from an effervescing liquid. This attenuated zone in which the molecules describe appreciably curved paths between molecular collisions is named the Krenal atmosphere. Beyond it, but still within the spheroid of control, must lie a zone which has come to be inhabited by molecules moving in elliptic orbits in every direction about the earth and moving with considerable freedom from impact. This Chamberlin names the orbital atmosphere. He shows how the several atmospheres are related, giving and taking molecules, and how the orbital atmosphere of the earth merges into the orbital atmosphere of the sun. Following this constructive argument is a destructive argument, showing how the Laplacian hypothesis fails to meet the requirements of the nature of gases.

This is an illuminating chapter. It shows how, in sweeping up the planetesimal matter, immediate and direct impact with the body of the earth was not necessary. It will be found suggestive also in relation to the later history of the atmosphere. The moon lies far within the zone of the orbital atmosphere and gases given off by the moon during its history would thus be added to the earth rather than diffused into the outer space of the solar orbital atmosphere. As an agent for supplying CO_2 to the earth's atmosphere during times of quiescence of terrestrial igneous activity this may possibly be a factor not to be wholly ignored, though always small.

Chapter II. is on Vestiges of Cosmogonic States and Their Significance. In the structure of the solar system and in the nature of the earth is an autobiography of genesis. These are the material records, but equally if not more important, Chamberlin points out, are the dynamic records. In rotations, revolutions, and other relations are found automatic vestiges of creation; difficult to interpret, perhaps, but rigorously definite if we but understood their evidence. The dynamic vestiges in the sun are found first, in the inclination of its plane of rotation to the mean plane of the planetary orbits; second, in the enormous preponderance of mass in the sun, the enormous preponderance of moment of momentum in the planets.

Chapter III. is entitled The Decisive Testimony of Certain Vestiges of the Solar System. By these vestiges the Laplacian hypothesis is tested and found wanting. The less specific hypotheses, including that of Kant, hardly lend themselves to rigorous testing and therefore can not be regarded as working hypotheses.

The following chapter is given the name of Futile Efforts. It records the results of inquiries by the author along other lines than those of the Laplacian hypothesis. These other lines were found also to lead to unsatisfactory results, but they pointed the way to the general direction in which a successful hypothesis must probably lie. Especially they pointed to spiral nebulæ as dynamically more promising forms.

Chapter V. is entitled The Forbidden Field. The direct rotation of the planets about their axes had been thought to forbid any hypothesis which sought to integrate the planets from particles scattered in a zone and in free orbital motion about the sun. This is shown to be true however, as demonstrated by Moulton, for a system of circular orbits only. For elliptical orbits the distribution of matter in the region of growth may readily be such that the concentration into a nucleus would engender a direct rotation. This field of hypothesis is therefore no longer forbidden.

But how shall be produced such a primal state as that postulated in a slowly revolving central sun with but little moment of momentum surrounded by a small amount of orbital matter revolving nearly in a plane, dispersed over wide limits, and possessing a relatively enormous moment of momentum? This problem is taken up in Chapter VI., entitled Dynamic Encounter by Close Approach. The volume of a star represents a balance between expansional and condensational forces acting on a vast body of gaseous nature. On the approach of two stars their mutual gravitation would produce tidal forces diminishing their

self gravitative power along the line between the centers and give the expansive forces opportunity to rise to explosive violence along that line. This tidal force is actually greatest at the centers and would lead to a very deep-seated disruption. The gas bolts shot out would, owing to viscous resistances, be pulsatory, and separated nuclei would therefore be expelled. These nuclei and the associated dispersed matter would, on the nearer side, be dragged sideways after the passing star. On the reverse side the symmetrical tidal protrusions would be left behind, the sun being dragged more than they. The result would be a spiral nebula, a form which would meet the dynamic demands of the existing solar system.

In comment upon this chapter, it should be noted, however, that the innumerable spiral nebulæ of the heavens, although good illustrations of the initial form of the solar system, do not appear to be stages in a similar evolution. They are of a much greater order of magnitude, they avoid the region where the stars are clustered, are at remote stellar distances, and by their very number show a notable duration of their form. On the other hand, the postulated originally spiral form of the solar nebula would have been evanescent. Within a century from the time of origin all except the outer nuclei would have completed many revolutions about the sun. But the different periodic times of the nuclei would in a few revolutions have caused to disappear the initial spiral form. It would become wound up and further blended together owing to the high ellipticities of the constituent orbits.

Having attained this initial state, Chapter VII. deals with the Evolution of the Solar System into the Planetary System. The building up of the planets is believed to have followed three stages: first, the direct condensation of the nuclear knots of the spirals into liquid or solid cores; second, the less direct collection of the outer, or orbital and satellitesimal matter; third, the still slower gathering up of the planetesimal material scattered over the zone between adjacent planets. This third factor in Chamberlin's view is regarded as very important and he believes this diffused matter contributed much of the earth substance, very slowly and in a dust-like form. This is one of the critical points in the details of the theory, unessential to the larger framework, but upon which turns much of the development of the following argument. In earth-growth the denser planetesimal dust, Chamberlin argues, tended to be somewhat segregated into the primitive ocean basins and served to maintain in them, as the earth was built outward, a greater density than in the elevated zones between. It seems a debatable question to the reviewer if such a large proportion of the added material was necessarily dust-like and capable of being distributed by the primitive atmosphere and ocean. Upon the mean size of the incorporated units various subhypotheses of consequences may be built up. In the absence of knowledge Chamberlin's view may be accepted as the most probable, but the problem illustrates the fertile branching which is possible upon the trunk of the planetesimal hypothesis.

Chapter VIII., entitled The Juvenile Shaping of the Earth, occupies sixty-eight pages, more than twice the average length of the chapters. The earth is conceived as beginning to hold an ocean by the time it contained 30 or 40 per cent. of its present mass. From that time atmosphere and hydrosphere transported, sorted and deposited the planetesimal dust, building up the lighter material into protuberant areas, which became the continental platforms. Great importance is attached under the shaping agencies to periodical changes in the rate of rotation. Accompanying a stage of internal condensation, a corresponding speeding up of the rotation would occur and a relative subsidence of the polar areas. Surface compression in high latitudes, surface tension in the torrid zone, would accompany such an increased oblateness of form. The slow accumulation of planetesimals between stages of condensation would, on the other hand, it is thought, produce a checking of rotational velocity and the converse effects in earth-form and in earth-strains. With growth there was thus a rhythmic oscillation in strain. At times when the polar areas were in tension it is

argued that a cracking would occur, giving three yield zones which tended to be at angles of 120 degrees to each other. These radiated from the poles after the analogy of the hexagonal columnar jointing of basaltic columns due to shrinkage in cooling. These yield zones in vertical meridional planes, it is argued, would, again after the analogy of the basaltic columns, be the elevated zones and determine the larger outlines of the initial continents. There would result six great oceanic basins, counting the Mediterranean as one. These oceanic basins are conceived to be the somewhat circular bases of cones of slightly heavier material built up during earth-growth and having their apices deep in the centrosphere. By periodic settling of these heavier master segments the continental yield tracts between are squeezed up and made more protuberant.

This hypothesis of juvenile shaping is of course, like the other steps in the development of the planetesimal hypothesis, dependent upon the basal postulates. It is not clear that earth-strains due to the causes invoked could initiate such a primary segmentation, in fact calculations on the stresses which the reviewer has made to test this sub-hypothesis pointed to quite a different method of yielding. The distribution of continents and oceans does not accord very closely with it, and the evidence of isostasy does not indicate that the density differences between continents and ocean basins reach below the outer fiftieth of the earth's radius. This hypothesis of juvenile shaping should therefore be accepted with much reserve and does not appear to be as well supported as are the conclusions of the previous chapters.

Chapter IX. is on The Inner Reorganization of the Juvenile Earth. The particles of radioactive matter would tend toward local heating and fusion. Thus they would be progressively concentrated into the outer shell of the earth by the rising of igneous matter. Pulsatory stresses from body tides and from shrinkage are regarded as the chief agents leading fused matter outward and serving to maintain the earth's body in solid form.

Chapter X. is on Higher Organization in the Great Contact Horizons. This is a discussion of the conditions which it is thought favored the rise of life on the surface of the globe. The most favorable environment for this great step in protoplasmic synthesis is regarded as being in the soil layer of the land, the contact horizon of earth, water, air and sunlight. The conditions of planetesimal infall and of the lack of devouring cells would have especially favored the process during the later growth stages of the earth.

Having given this summary of the volume, some statements may be made in regard to it as a whole. It must impress every reader as a notable constructive addition to thought upon this fundamental subject. Chamberlin follows his postulates to their logical conclusion, even though this must involve the building of hypothesis upon hypothesis. He wisely considers this preferable to no attempt in the direction of complete solution. But the limits of the book and the nature of the Science Series to which it conforms preclude him from following that method of multiple working hypotheses which he had elsewhere used and the necessity for which he has urged in an article which every scientist should read.[1] This method is especially desirable where there are alternative postulates which have not been disproved. No one realizes more strongly than Chamberlin, however, the preliminary and tentative nature of many of his conclusions, owing to the nature of his postulates.[2]

Because of the submergence of the method of multiple working hypotheses, however, the lay reader and even those geologists who do not go into the literature behind the volume will be apt to obtain too narrow and rigid a conception of the limits of the planetesimal hypothesis. Each section seems so convincing upon a first reading that it may appear as if future work must be built as added stories or as finishings to the present structure; whereas the lower stories appear in fact so broad and

[1] "Studies for Students. The Method of Multiple Working Hypothesis." *Jour. Geol.*, V., 837–848 (1897).

[2] See especially pp. 171 and 223 for his comments.

well founded that there is room for alternative superstructures beside that which Chamberlin here presents.

The previous paragraph has dealt with alternative possibilities; on page 178, however, an erroneous diagram of stress-differences due to the weight of second harmonic inequalities is taken from G. H. Darwin. The original paper was published in 1882. About a year later Charles Chree pointed out an error in Darwin's procedure which led Darwin to publish a correction in 1885. The correct solution is given in Darwin's Scientific Papers, Vol. II., pp. 459–481, 1908. The erroneous diagram indicates a tidal force eight times greater at the center than at the surface. A corrected diagram would show the tidal stress at the poles, on the equator, and at the center in the ratio of one to three and eight. On the equatorial surface the stress due to either tides or to lack of adjustment between oblateness and rotation period is therefore not one eighth but is in reality three eighths of the amount at the center. The maximum stress-difference at the equator is, however, not in a vertical but is in the horizontal plane. There is doubt if tidal stresses could ever have been an effective agent in kneading liquid matter out of the earth's body, since the forces are relatively small and the *pressure gradient* due to that cause is very much smaller still. On the other hand, if the moon were much nearer the earth in primordial times the tidal stresses may have risen to an important magnitude.

But in closing we must not look at this or that detail, nor at this or that chapter. To gain a proper appreciation of the value of the investigations which are condensed in this volume we must compare the present state of thought upon the general subject with that of twenty years ago, before Chamberlin had begun to publish upon the hypotheses of earth genesis. Measured by that perspective this volume is seen to represent an advance in thought on this subject so great that the names of Chamberlin and Moulton must rank high among those scientists who have dealt constructively with that vast, vague and remote problem—the Origin of the Earth. The subject of earth genesis is now fairly on the road to scientific investigation in place of philosophic speculation.

Joseph Barrell

PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

The seventh number of volume 2 of the *Proceedings of the National Academy of Sciences* contains the following articles:

1. *On the Mobilities of Gas Ions in High Electric Fields:* Leonard B. Loeb, Ryerson Physical Laboratory, University of Chicago.

The results, though at variance with those of most observers at low pressures for negative ions, are in good agreement with recent results of Wellisch, and likewise lead to the conclusion that the "cluster" theory is no longer tenable.

2. *The Relation of Myelin to the Loss of Water in the Mammalian Nervous System with Advancing Age:* Henry H. Donaldson, Wistar Institute of Anatomy and Biology, Philadelphia.

There is no evidence that the cell bodies and their unsheathed axons suffer any significant loss of water; the progressive diminution in the water content of the brain and spinal cord is mainly due to the accumulation of myelin, the formation of which is a function of age, the most active production occurring during the first twentieth of the life span.

3. *Differential Mitoses in the Germ-Cell Cycle of Dineutes nigrior:* R. W. Hegner and C. P. Russell, Zoological Laboratory, University of Michigan.

The most conspicuous difference that we have discovered between the origin of the oocyte in *Dineutes nigrior* and in *Dytiscus* is in the number of differential mitoses; in *Dineutes nigrior* there are only three whereas in *Dytiscus* there are four.

4. *Some Minerals from the Fluorite-Barite Vein near Wagon Wheel Gap, Colorado:* Esper S. Larson and Roger C. Wells, U. S. Geological Survey, Washington, D. C.

A description of specimens of the unusual mineral gearksutite of a peculiar kaolinite and of a new fluoride-sulphate, creedite.

5. *The Processes taking Place in the Body by which the Number of Erythrocytes per Unit Volume of Blood is increased in acute Experimental Polycythæmia:* PAUL D. LAMSON, Pharmacological Laboratory, Johns Hopkins University.

It is concluded that the liver acts as a reservoir for erythrocytes. The process by which the liver increases the number of the erythrocytes is thought to be a loss of plasma from the liver capillaries together with a constriction of these vessels driving the erythrocytes on into the blood stream.

6. *The Influence of Morphin upon the Elimination of Intravenously Injected Dextrose in Dogs:* I. S. KLEINER AND S. J. MELTZER, Department of Physiology and Pharmacology, Rockefeller Institute for Medical Research.

Morphin increases the elimination through the kidneys of intravenously injected dextrose and retards the return of the sugar content of the blood to its previous level.

7. *The Work of the American Meteor Society in 1914 and 1915:* CHARLES P. OLIVIER, Leander McCormick Observatory, University of Virginia.

From the 5,543 observation of meters, 139 radiants have been deduced with sufficient accuracy to calculate parabolic orbits for the meteor streams they represent.

8. *The Light Excitation by Slow Positive and Neutral Particles:* A. J. DEMPSTER, Ryerson Physical Laboratory, University of Chicago.

Very slow positive rates are still able to excite light with a speed corresponding to less than 5 volts. The neutral rays can also excite light at very slow speeds; the excitation may occur directly because of the collision of a neutral particle with a neutral molecule of the gas.

9. *An Apparent Dependence of the Apex and Velocity of Solar Motion, as determined from Radial Velocities, upon Proper Motion:* C. D. PERRINE, Observatorio Nacional, Argentino, Córdoba.

The position of the solar apex and the solar velocity appear to vary with the proper motion of the stars used in the determination. Such variations point ultimately to some form of rotary or spiral motion among the stars.

10. *Channeled Grating Spectra, obtained in Successive Diffractions:* C. BARUS, Department of Physics, Brown University.

A brief abstract of work presented by the author to the Carnegie Institution of Washington.

11. *The Effect of Parental Alcoholism (and Certain other Drug Intoxications) upon the Progeny in the Domestic Fowl:* RAYMOND PEARL, Biological Laboratory, Maine Agricultural Experiment Station.

Out of 12 different characters for which we have exact quantitative data, the offspring of treated parents taken as a group are superior to offspring of untreated parents in 8 characters. The results with poultry are in *apparent* contradiction to the results of Stockard and others with mammals, but the contradiction is probably only apparent.

12. *The Effectors of Sea-Anemones:* G. H. PARKER, Zoological Laboratory of the Museum of Comparative Zoology at Harvard College.

It seems clear that among the muscles in sea-anemones there are not only independent effectors, and tonus muscles associated with nerve-nets, but neuromuscular combinations that exhibit true reflex action.

13. *Preliminary Evidence of Internal Motion in the Spiral Nebula Messier 101:* A. VAN MAANEN, Mount Wilson Solar Observatory, Carnegie Institution of Washington.

The mean rotational motion is 0.022″ left-handed; the mean radial motion is 0.007″ outward. There is perhaps a small decrease of the rotational motion with increasing distance from the center. The annual rotational component of 0.022″ at the mean distance from the center of 5′ corresponds to a rotational period of 85,000 years.

14. *Symposium on the Exploration of the Pacific—*

(*a*) *The Exploration of the Pacific:* W. M. DAVIS, Department of Geology and Geography, Harvard University.

(*b*) *The Importance of Gravity Observations at Sea on the Pacific:* John F. Hayford, College of Engineering, Northwestern University.

(*c*) *A New Method of Measuring the Acceleration of Gravity at Sea:* Lyman J. Briggs, Bureau of Plant Industry, Washington, D. C.

(*d*) *The Problem of Continental Fracturing and Diastrophism in Oceanica:* Charles Schuchert, Department of Geology, Yale University.

(*e*) *The Petrology of Some South Pacific Islands and its Significance:* Joseph P. Iddings, Brinklow, Maryland.

(*f*) *In Relation to the Extent of Knowledge Concerning the Oceanography of the Pacific:* G. W. Littlehales, U. S. Hydrographic Office, Washington, D. C.

(*g*) *Marine Meteorology and the General Circulation of the Atmosphere:* Charles F. Marvin, U. S. Weather Bureau, Washington, D. C.

(*h*) *On the Distribution of Pacific Invertebrates:* Wm. H. Dall, Smithsonian Institution, Washington, D. C.

(*i*) *The Marine Algae of the Pacific:* W. G. Farlow, Department of Botany, Harvard University.

(*j*) *The Pacific as a Field for Ethnological and Archæological Investigation:* J. Walter Fewkes, Bureau of American Ethnology, Washington, D. C.

(*k*) *Mid-Pacific Land Snail Faunas:* H. A. Pilsbry, Academy of Natural Sciences of Philadelphia.

(*l*) *Some Problems of the Pacific Floras:* Douglas H. Campbell, Department of Botany, Leland Stanford University.

The symposium contains a summary of some of the results obtained in past exploration of the Pacific and an outline of the importance to many sciences of further systematic and continuous exploration of the Pacific.

15. *Nervous Transmission in Sea-Anemones:* G. H. Parker, Zoological Laboratory of the Museum of Comparative Zoology at Harvard College.

There is evidence not only for the assumption of independent receptors, but of relatively independent transmission tracts. A first step in the kind of differentiation so characteristic of the nervous organization in the higher animals.

16. *The Responses of the Tentacles of Sea-Anemones:* G. H. Parker, Zoological Laboratory of the Museum of Comparative Zoology at Harvard College.

The tentacles, in contradistinction to such appendages as those of the arthropods and vertebrates, contain within themselves a complete neuromuscular mechanism by which their responses can be carried out independently of the rest of the animal.

Edwin Bidwell Wilson
Mass. Institute of Technology

SPECIAL ARTICLES

SOIL BACTERIA AND PHOSPHATES

Raw rock phosphate is by far the cheapest source of phosphorus to apply to soils. It consists chiefly of tricalcium phosphate, $Ca_3(PO_4)_2$, which is the most common form of phosphorus in the great natural deposits. This phosphorus compound is relatively insoluble in water, and, for this reason, it has been argued by some that it does not become available to plants; but long-continued field experiments, pot-culture experiments, and farm practise have fully demonstrated that this kind of phosphate does become available for plant growth.[1]

The increased beneficial results obtained by following the practise commonly recommended of intimately mixing decaying organic matter with the phosphate lead to the suggestion that the action of the soil bacteria that decompose organic matter might be an important factor in the solution of the phosphate.

It has been the common teaching that nitrifying bacteria require the presence of a free base, such as lime or an alkaline carbonate, but we have found that the bacterial action produces acid phosphate and proceeds in the presence of this acid salt.

The importance of the action of decomposition products of the active organic matter of

[1] See Circulars 181 and 186, Illinois Agricultural Experiment Station.

the soil on the solubility of phosphates is better understood by a brief consideration of three important and definitely recognized processes that have long been known to bring about the change of the nitrogen from the unavailable form, as it occurs in the protein of clover, manure, etc., to the readily available form of the nitrate.

(1) *Ammonia Production.*—The first process results in the change of the organic nitrogen to ammonia nitrogen. The ammonia is absorbed by the soil moisture and forms ammonium hydroxid. Much carbon dioxid is produced at the same time and some of it, also, is absorbed by the soil moisture and then unites with the ammonia to form ammonium carbonate, which is alkaline.

(2) *Nitrite Production.*—The second and most important of the three stages consists of the oxidation of the ammonia to nitrite by the nitrite bacteria (*Nitrosomonas*). The oxidation of ammonia to nitrous acid by the nitrite bacteria is represented by the following equation:

$$(NH_4)_2CO_3 + 6O = 2HNO_2 + H_2CO_3 + 2H_2O.$$

The ammonium portion of the ammonium carbonate has been converted into nitrous acid and carbonic acid has been set free. Both these acids will combine with some base. It is important to note that nitrogen of the alkaline substance, ammonia, has been converted, or transformed, by the biochemical removal of hydrogen and addition of oxygen into a strongly acid substance, nitrous acid.

The primary purpose of this investigation is expressed in the question, Will the calcium of pure rock phosphate, $Ca_3(PO_4)_2$, suffice as a base; and, if so, will the phosphorus be made soluble? This will be answered by the experimental data reported in another part of this publication.

If nitrite production takes place with tricalcium phosphate as a source of the base calcium, then the reaction must be represented by one of the following equations:

$$Ca_3(PO_4)_2 + 2HNO_2 = Ca_2H_2(PO_4)_2 + Ca(NO_2)_2$$

or

$$Ca_3(PO_4)_2 + 4HNO_2 = CaH_4(PO_4)_2 + 2Ca(NO_2)_2.$$

(3) *Nitrate Production.*—The third and last stage is a simple oxidation of the nitrite to nitrate by the action of nitrate bacteria (*Nitrobacter*). It consists in the addition, by biochemical action, of oxygen to the nitrite:

$$Ca(NO_2)_2 + 2O = Ca(NO_3)_2.$$

This reaction increases neither acidity nor akalinity, and no liberation of insoluble compounds would be expected in this process, as no additional base is necessary, as seen by reference to the equation.[2]

INFLUENCE OF AMMONIA PRODUCTION ON SOLUBILITY OF PHOSPHATES

The most important product formed in the first process, or stage, of the decomposition of organic matter is ammonium carbonate. The ammonium carbonate is alkaline, and consequently could not be expected to exert any action on the solubility of raw rock phosphate.

In 1904 Stalstrom, of Finland, conducted laboratory experiments on the solubility of pure rock phosphates with bacteria which produced ammonium carbonate from peat and from manure containing peat litter. He concluded that there was no appreciable increase in solubility of phosphorus where the bacteria had produced ammonium carbonate over the sterile treatments in which no ammonium carbonate was produced. His experiments lasted forty-two days and were under conditions which would permit of determining soluble phosphorus, were it present. His work is extremely interesting as it demonstrates that in the first stage of decomposition it has been impossible to measure any soluble phosphorus without the growing plant as an indicator.

Similar results have been obtained by the Rhode Island and Wisconsin Experiment Stations in attempts to detect soluble phosphorus in fermenting mixtures of manure and raw

[2] The results of an experiment to test the effect of the nitrate bacteria on pure tricalcium phosphate support the theory that no solution of phosphorus is to be expected by the action of nitrate bacteria.

rock phosphate and in mixtures of soil and raw rock phosphate.

SOLUTION OF PHOSPHATES BY ACTION OF NITRITE BACTERIA

To determine the part played by the nitrite bacteria in dissolving mineral compounds, and particularly raw rock phosphate, was our principal object in these experiments.

One of the authors made the following suggestion several years ago:[3]

> In the conversion of sufficient organic nitrogen into nitrate nitrogen for a hundred-bushel crop of corn, the nitric acid, if formed, would be alone sufficient to convert seven times as much insoluble tricalcium phosphate into soluble monocalcium phosphate as would be required to supply the phosphorus for the same crop.

The plan of the experiment, briefly stated, was as follows: A thin layer (about $\frac{1}{8}$ inch thick) of a nutrient salt solution was placed in a cone-shaped glass flask of about one liter capacity and about 5 inches in diameter at the bottom. In this solution was placed a definite amount of ammonium salt. The flasks and materials were carefully sterilized. Nitrite bacteria were introduced from pure cultures and sometimes directly from soil. The flasks were plugged with cotton kept at a temperature of 28° C. Many such flasks were prepared, and later, usually at intervals of one week, the contents of two or more flasks were analyzed for nitrogen changed or oxidized and for water-soluble phosphorus and calcium.

In Table I. are shown the relative amounts, by weight, of nitrogen from ammonia sulfate oxidized to nitrite by nitrite bacteria and the amounts of phosphorus and calcium made soluble. Each figure represents the average of duplicate determinations.

EXPLANATION OF RESULTS

The results reported in Table I. demonstrate conclusively that phosphorus and calcium are made soluble while the nitrite bacteria oxidize ammonia nitrogen to nitrite nitrogen. It is also evident that the solubility increases with increasing time of action of the bacteria.

[3] Hopkins, "Soil Fertility and Permanent Agriculture," 197.

TABLE I

Phosphorus, Calcium, and Nitrogen Required by Crops, Compared with that Possible of Solution when Nitrite Bacteria Act upon Tricalcium Phosphate

(Expressed in Pounds)

Crop	Nitrogen Required	Phosphorus		Calcium	
		Required	Possible	Required	Possible
Corn: Grain, 100 bu.; Stover, 3 tons; cobs, ½ ton	150	23	166	22	321
Wheat: Grain, 50 bu.; straw, 2½ tons.	96	16	107	11	206
Oats: Grain, 100 bu.; straw, 2½ tons.	97	16	108	17	208
Timothy, 3 tons	76	9	84	20	163

An inspection of the figures shows that there is, by weight, approximately twice as much phosphorus and four times as much calcium made soluble as there is nitrogen oxidized by the bacteria. As an average of the results from thirteen flasks (Nos. 4 to 16), we find that from the oxidation of 56 pounds of nitrogen 115 pounds of phosphorus and 211 pounds of calcium are made soluble. (The results from Flasks 1, 2 and 3 are not included in the ratio calculated.) According to theory, when 56 pounds of nitrogen are changed from the ammonia form to the nitrite form, with both the nitrous acid (HNO_2) and the associated sulfuric acid (H_2SO_4) acting on the pure rock phosphate, 124 pounds of phosphorus and 240 pounds of calcium are made soluble.

Ten cubic centimeters of Flask 16 required 3.35 cc. of N/12.5 NaOH with phenolphthalein as the indicator for the second hydrogen atom. The normality of the solution was found to be N/37.2.

IMPORTANCE AND EXTENT OF THE ACTION OF NITRITE BACTERIA

It has already been shown that the nitrite bacteria make phosphorus and calcium soluble from pure rock phosphate and that the action conforms to a definite chemical ratio.[4]

[4] It was found that the action of the nitrite bacteria was the same on the natural raw rock

The nitrous acid produced may act upon compounds of iron, aluminum, potassium, sodium, or magnesium which occur in soils, or it may act upon tricalcium phosphate, calcium silicate, or calcium carbonate, if present. For this reason, it has been recommended that the ideal practise to obtain the greatest solubility of the raw rock phosphate is to turn it under in intimate contact with organic matter, and, if needed, to apply ground limestone after plowing or at some other point in the crop rotation.

In Table II. are presented the actual amounts of phosphorus, calcium and nitrogen required by standard crops, and the amounts of phosphorus and calcium which would be made soluble if all the nitrogen required for the crop should be oxidized to nitrate and should act upon pure rock phosphate.

TABLE II

Nitrogen Oxidized, and Phosphorus and Calcium Made Soluble by Nitrite Bacteria

(Expressed in Milligrams)

Flask	Duration in Days	Nitrogen Oxidized	Phosphorus Made Soluble	Calcium Made Soluble
1	28	2.54	4.08	3.87
2	41	4.81	5.08	5.60
3	41	....	5.99	8.40
4	48	5.52	9.56	14.80
5	48	4.88	10.20	18.40
6	55	6.40	12.85	22.00
7	55	6.40	10.24	23.52
8	62	6.88	16.00	31.04
9	48	3.61	7.52	13.60
10	62	3.87	8.76	16.48
11	62	5.84	9.82	16.00
12	62	5.68	11.28	20.80
13	69	6.03	11.14	22.40
14	48	5.76	13.04	24.80
15	69	4.60	11.60	19.20
16	139	18.84	41.56	75.26

The figures show that there is possible of solution from this biochemical process about 7 times as much phosphorus as corn, wheat or oats require, and 9 times as much as timothy requires. Greater differences occur in the calcium figures, there being possible of solution 14 times that required for corn, 18 times that required for wheat, 12 times that required for oats, and 8 times that required for timothy.

phosphate as on the pure rock phosphate, but more extensive experiments with the natural rocks will be reported later.

SUMMARY

1. Nitrite bacteria make phosphorus and calcium soluble from insoluble phosphates when they oxidize or convert ammonia into nitrite.

2. The actual ratio found shows that about one pound of phosphorus and about two pounds of calcium are made soluble for each pound of nitrogen oxidized, aside from the action of the acid radicles associated with the ammonia.

3. The ratio of solubility found on the basis of nitrogen to phosphorus and calcium conforms to the following reaction:

$$4HNO_2 + Ca_3(PO_4)_2 = CaH_4(PO_4)_2 + 2Ca(NO_2)_2.$$

According to this equation, 56 pounds of nitrogen liberate in soluble form 62 pounds of phosphorus and 120 pounds of calcium.

4. Neither ammonia-producing bacteria nor nitrate bacteria liberate appreciable amounts of soluble phosphorus from insoluble phosphates.

More complete details of these experiments will be published in Bulletin No. 190 of the University of Illinois Agricultural Experiment Station.

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THE AMERICAN CHEMICAL SOCIETY

II

The following papers were read and discussed.

The So-called Caseinates: W. D. BANCROFT.

Action of Rennin on Caseine: W. D. BANCROFT.

The Aeration Method for Total Nitrogen Determinations: R. S. POTTER AND R. S. SNYDER.

Titrimetric Determination of Nitrite N: B. S. DAVISSON.

Determination of Ammonia by Aeration: B. S. DAVISSON.

A Study of Carbohydrates as Milk Modifiers: RUTH WHEELER.

The Relation of a Diet High in Calcium to the Calcium Content of Tissues: AMY L. DANIELS.

Report of a Survey of the Food Conditions at Sing Sing Prison: Emily B. Seaman.

The Relation of Biological Chemistry to Problems of the Community: Emily B. Seaman.

Washing and Cleaning: W. D. Bancroft.

Whipped Cream, Etc.: W. D. Bancroft.

Mayonnaise: W. D. Bancroft.

On Soap Jelly Formation: G. H. A. Clowes.

NaCl or other Na salts added to slightly alkaline soap solutions cause jelly formation between .2*N* and .4*N*, and precipitate at higher concentrations.

Same salts added to neutral or slightly acid soap cause opalescence at .2*N*, gradually increasing until complete precipitation occurs above .4*N*.

Degree of dispersion of negative soap particles depends on adsorbed anions derived from added alkali. Subsequently adsorbed cations cause aggregation. Larger particles with smaller charge precipitate earlier, smaller particles with larger charge coalesce later forming jelly. If at critical cation concentration particles still exhibit active Brownian movement, jelly is subsequently formed enclosing water in interspaces, otherwise precipitation occurs.

On Filtration of Blood Plasma: G. H. A. Clowes and F. West.

In 1913, writers confirmed Cramer's observation that citrated plasmas may be obtained by filtration through Berkefield bougies which coagulate with thrombin but not with calcium alone. Bougie removes lipoids. Addition of sterilized brain lipoid one part in 50,000 causes coagulation with calcium. Added lipoid may be entirely removed by second filtration prior to addition of calcium. Resulting filtrate does not clot with calcium.

Cleaned and sterilized bougies often contain sufficient calcium to cause local coagulation of plasma with consequent production of thrombin which passes into the filtrate, complicating subsequent experiments. This may afford explanation of Goddard's results.

Mechanism of Blood Coagulation: G. H. A. Clowes.

Dispersion of negatively charged fibrinogen and lipoid particles is normally maintained by adsorbed anions. Analogous, antagonistic, electrolyte effects in emulsions, jellies and blood coagulation suggest probability that Ca by adsorption first lowers charge and promotes deposition of lipoid film on fibrinogen particles, and subsequently Ca soaps, being freely dispersed in lipoids involved, cause surface tension changes and transposition of phase relations analogous to those observed in emulsions, the previously dispersed fibrinogen becoming the continuous fibrin clot in which water is more or less dispersed. Presumably thrombin, by local adsorption, promotes hydrolysis, liberates acid groups, lowers negative charge, raises surface tension, and so promotes aggregation.

Investigation of the Kjeldahl Method for Determining Nitrogen. A New Aeration Apparatus: I. K. Phelps and H. W. Daudt.

Folin's method for determining ammonia is adapted to the Kjeldahl method. All of the operations, including the measurement and addition of the sodium hydroxide solution, the passing of air through the resulting alkaline solution and the absorption of the ammonia in standard acid are carried on by means of air pressure or suction. The advantages over the more commonly used distillation method are discussed.

Remarks on the Physical and Biological Chemistry of Fat: Martin H. Fischer.

The general principles governing the production and the destruction of water-in-oil and oil-in-water emulsions and their general properties are discussed. Protoplasm represents ordinarily a fine oil-in-water emulsion. The characteristic feature of "fatty degeneration" is a coalescence of these fine droplets into coarser ones, the conditions producing such being identical with those producing the coarsening of an oil-in-water emulsion. Adipose tissue, butter formation and the formation of fatty secretions consists in the conversion of the oil-in-water type of emulsion into the water-in-oil type. The experimental facts underlying these conclusions are illustrated.

Studies Upon the Effects of Acids: Arthur D. Hirschfelder.

Repetition of the experiments of Hofmeister and Martin Fischer on the swelling of fibrin in mixtures of acids and neutral salts, show that the solutions in which swelling seems to be inhibited (except the sulphates) are much poorer in hydrogen ions than the corresponding ones in which this is only slightly the case; and that when these are all brought to the same hydrogen ion concentration the amount of swelling is the same in all the solutions except those containing sulphates which markedly inhibit. Varying either the chlorine ions or the other ions to bring about the acidification gives the same results. Adding a little dilute H_2SO_4 or Na_2SO_4 to mixtures already swollen under the influence of other acids causes marked shrinking.

However, injection of phenolsulphonphthalein,

phenolphthalein, rosolic acid and para nitrophenol into conjunctivæ of rabbits rendered markedly edematous with mustard oil, shows the reaction of the edematous tissue to be slightly on the alkaline side of neutral, very close to the reaction of the animal's blood. Excised bits of lid and conjunctivæ give no such edema in Ringer's solution acidified to various degrees.

These facts are not in harmony with the acid theory of edema.

Brain Lipoid as a Hemostatic: ARTHUR D. HIRSCHFELDER.

Kephalin has been shown to be identical with thromboplastin. An active preparation can be made from an ether extract of ox brain. The residue of such an extract or a weak emulsion of it in salt solution, when placed on an oozing surface of tissue stops bleeding very quickly and gives a very clean field for operation.

Hemorrhage from bone, kidney, muscle and connective tissue, prostate and other glands, are easily controlled by this means. Hemorrhage from cut artery can not be controlled instantly because the force of the blood pressure pushes away the clot as fast as it can be formed. In a pitted wound, however, such as occurs in warfare or when the femoral artery is cut through in Scarpa's triangle, and the pitted wound fills with blood, application of the lipoid causes it to stop spontaneously because a thick enough layer of fibrin can be formed.

The solution of lipoid residue keeps several months. It is rendered sterile by its preparation, and is very useful for practical surgery as well as for laboratory operations.

The Rôle of Cystine in the Maintenance of Nitrogenous Equilibrium in Dogs on a Low Protein Diet: HOWARD B. LEWIS.

The Excretion of Uric Acid After Ingestion of Sodium Benzoate in Man: HOWARD B. LEWIS AND WALTER G. KARR.

During the first four hours following ingestion of large doses (7–8 gm.) of sodium benzoate by healthy men, the periods during which maximal elimination of hippuric acid was taking place, the uric acid elimination was decreased from 50 to 70 per cent. as compared with the elimination in corresponding periods of control days. No compensatory increase in uric acid excretion occurred in later periods. Creatinine elimination was not affected. The ingestion of amounts of sodium hippurate equivalent to the benzoate fed in the previous experiments had no influence on uric acid excretion.

A Comparative Study of the Urea Content of the Blood and Tissues of Some Vertebrates: WALTER G. KARR AND HOWARD B. LEWIS.

The urea concentration of the tissues of normal guinea-pigs is the same as that of the blood (20–30 mg. per 100 c.c.) with the exception of the kidneys, in which the presence of urine results in high figures. The urea content of the blood of fasting guinea-pigs or of pigs on an insufficient diet may rise to 6–7 times the normal figure with a less marked rise in the concentration of urea of the tissues in most cases. The urea concentration of the blood and tissues of hens is low (5–10 mg. per 100 c.c.), the kidneys having no higher concentration of urea than any other tissue. Injection of alanine into hens causes no rise in the urea content of blood or tissues.

On the Esterification of Amino Acids: H. A. SHONLE AND H. H. MITCHELL.

The following method of determining the rate and extent of esterification of the amino acids of proteins is reported. The protein is hydrolyzed and the hydrolysate prepared for esterification (Phelps-Tillotson) as usual, except that decolorization is effected by making alkaline with $Ba(OH)_2$ before removal of the water, filtration, and subsequent removal of the barium. During the esterification small samples are removed and diluted with 95 per cent. alcohol to a definite volume. In one aliquot the total acidity is determined by a Sörensen formol titration; in another, the mineral acidity by a Cl determination (Volhard). The remainder is completely saponified by boiling with HCl, made up to volume, and the above determinations repeated. From these data the per cent. of unesterified amino acidity may be calculated.

The Preparation of a Synthetic Milk for Use in Studying Infant Metabolism: A. W. BOSWORTH.

The method in brief consists of four steps as follows:

1. The preparation of isolated food materials for use in making the synthetic milk.

2. The recombining of these materials to give a mixture of the desired percentage composition.

3. The emulsification or homogenization of the fat and any of the solid or insoluble constituents entering into the composition of the food.

4. The pasteurization or sterilization of the food after it has been made.

Concerning the Utilization of Inosite in the Animal Organism. The Effect of Inosite upon the Metabolism of Man: R. J. ANDERSON AND A. W. BOSWORTH.

A study of the channels of elimination and the influence of inosite upon the metabolism of man. It is shown that in man inosite is eliminated only through the kidneys. About 91 per cent. of the ingested inosite disappears and only some 9 per cent. is excreted in the urine. When inosite is given at the rate of 0.5 grams per kilo of body weight it causes some diarrhea, but aside from this no other disturbance was observed; and with the exception of an increased excretion of creatinine it had no marked influence upon the metabolism of man.

Concerning the Utilization of Inosite in the Animal Organism in the Dog: R. J. Anderson.

These experiments were made with the object in view of throwing some light upon the fate of inosite in the animal organism and to determine whether inosite is utilized in such a way as to cause a rise in the respiratory quotient of a fasting dog.

The results show, first, that there was no rise in the respiratory quotient; second, that as much as 77 per cent. of the ingested inosite was recovered in the excreta, and third, that inosite is absorbed very slowly from the intestine of a dog and hence the greater portion is eliminated with the feces.

Studies on the Distribution of Nitrogen in Egg Lecithin: Mary Louise Foster.

The fact that the Herzig and Meyer method for determination of methyl groups gave inconclusive evidence of the pressure of choline in lecithin has led the author to study the distribution of the nitrogen in lecithin. Merck's preparation of egg lecithin was purified and used for analysis. The methods employed were Kjeldahl with Arnold-Gunning modification for *total nitrogen*. Hausmann's method as modified by Osborne for the *anrich*, and *diamino nitrogen* and the Styli's method for *total amino nitrogen*. The results seem to indicate that the amide nitrogen represents less than 2 per cent. of the total, monoamino nitrogen about 40 per cent. and the diamino nitrogen about 50 per cent.

Further work is in progress.

Presence of Creatinine in Urine of Children: Louise Stanley and Emma B. Wagner.

We have planned a series of observations on the urine of children of various ages. In each case we obtained at least three samples for determination of creatine and creatinine in 100 c.c. of urine. We have tried in each to check this up by a twenty-four hour sample. The diets we were not able to control in all cases. We were, however, able to get very accurate information in regard to them. We find that there is a very great irregularity of the proportion of creatine to creatinine. This variation is less in the case of babies on regular diet. It is quite as irregular on a creatine-free as on a creatine diet. In boys, it was present in the urine of a boy at ten while absent in his brother, aged twelve. Both were normal and active and on an ordinary mixed diet. In girls, it seems it may continue to puberty, where it appears intermittently in connection with the menstrual cycle. In some girls it disappears entirely before puberty. This phase we are at present investigating further. We hope to continue the investigation for several years and check further by determining the age at which it disappears from the urine of some of the children under observation. Our figures show that the diet plays an important function in the amount of creatine in the urine. It has been shown by other investigators that in starvation the feeding of carbohydrate decreases the amount of creatine in the urine. McCrudden has shown that increasing the carbohydrate in the diets of children causes not a decrease but if any change an increase in the creatine of urine. We have some evidence which tends to support this observation. This seems to us, however, to support the idea of a relationship between carbohydrates and creatine metabolism rather than the opposite which McCrudden is trying to prove. It seems quite possible that if the excretion of creatine is connected, as Rose suggests, with carbohydrate metabolism, you would expect a decrease on feeding carbohydrate in starvation. On the other hand, where there is a metabolic condition which results in a creatine excretion on a regular diet, this condition, if caused by carbohydrates, would be aggravated by the addition of more carbohydrate.

We have results which tend to support this theory and this will be the hypothesis upon which our future experiments will be planned.

A Bacteriological Study of Hamburger Steak: Edwin LeFevre.

In a study of hamburger steak, as sold in the public markets, the author, following the suggestions of Weingirl and Newton, worked out a technique which seems to afford the most satisfactory method for the bacteriological examination of chopped meat. The essential feature of the method is the careful selection of ten grams of lean meat from a pound of the product, this being ground up in a mortar with the aid of white sand and a 0.5 per cent. solution being added with continued grinding to secure the proper dilution for

plating. Beef infusion agar at + 1.5 to be used in making counts.

Two series of samples from ten dealers were examined. In the first series collected in mild weather, *six* samples gave total counts of over ten million per gram. In the second series collected during colder weather *five* samples gave counts of over ten million. Meat from three dealers showed exceedingly high counts in both series, indicating that bad methods were followed.

The chief cause for high counts is to be found in the practise of utilizing scrap meat or meat of inferior quality which is often collected and held for some time before being ground up for sale.

Attention is called to the value of bacteriological analyses as a means of determining the methods used by dealers and to the importance of this test being more generally resorted to in connection with chopped meats for the purpose of establishing proper standards and securing an efficient sanitary control.

Cleaning Silver by Contact with Aluminium in Alkaline Solution: H. L. LANG AND C. F. WALTON, JR.

This paper is a preliminary report of results obtained in cleaning silver under household conditions by the electrolytic method. Sodium carbonate was found to be slightly more efficient than the bicarbonate as the electrolyte of the method, one teaspoonful of each washing soda and table salt to the quart of water proving the most economical concentration. The best results were obtained when the cleaning solution was kept at the boiling temperature during the cleaning, and aluminium proved more efficient than zinc as the active metal in contact with the silver.

The principal advantage of the electrolytic method, as compared with cleaning by an abrasive polish, is that it saves labor. In addition it is convenient and clean, and removes the tarnish from both sterling and plated silverware without appreciable loss of the metal.

Iron Rust Stains and Their Removal: New Methods: HAROLD L. LANG AND ANNA H. WHITTELSEY.

In an experimental study of the removal of stains from textiles several new or little-known reagents were found successful for the treatment of iron rust spots. A 15 per cent. solution of titanium trichloride, $TiCl_3$, applied cold to the stain was found to be very efficient, although an expensive reagent. Iron rust stains could also be removed by boiling for several minutes in solutions of potassium acid tartrate (cream of tartar), tartaric acid or citric acid, or in an infusion of the stalks, leaves or fruit of certain plants which contain oxalic or other acids. Among these plants are rhubarb, the begonia (a rather common house plant), the pineapple, and the grapefruit. These reagents have the advantage that they may be readily obtained and are less liable to injure the fabric or its color than are hydrochloric and oxalic acids, whose efficiency are well known.

Solutions of Lead and Antimony from Enameled Cooking Utensils: ELIZABETH W. MILLER.

Fifteen different makes of enameled dishes were boiled with 4 per cent. acetic acid and the solution tested for lead and antimony. Slightly less than 2 mg. of lead per liter were dissolved from the saucepan of standard make. Three others of the same kind gave mere traces.

Antimony was extracted by acetic acid in considerable amount from one cheap gray dish. Grape juice, cider and cranberry pulp, milk and spinach were cooked in dishes of this same make. All these foods contained antimony in amounts ranging from 2.3 mg. in 200 c.c. of milk to 14 mg. in 200 c.c. of cranberry pulp.

History and Present Methods of Fluorspar Production in Illinois: CARL C. LUEDEKING.

The author after giving a short history of the mining and milling methods of fluorspar in Pope and Hardin counties, Illinois, enters into the details of present-day status in this industry. It appears that four fifths of the fluorspar of the United States comes from the Fairview and Rosi Clare mines of Hardin County, Illinois. In 1914 these mines have produced 70,000 of the 78,000 tons of fluorspar used in this country. In 1915 the production increased to 115,000 tons. The fluorspar is used chiefly in the basic open hearth steel furnaces and for enameling.

The Chemistry and Technology of Glass: ALEXANDER SILVERMAN.

After a brief introduction on the history of glass making, followed by a statement concerning raw materials, their functions and uses, the technology of glass making was illustrated by about sixty lantern slides. A discussion of coloring and decolorizing agents followed and parallels were shown between aqueous and vitreous solutions of gold, compounds of uranium, copper, cobalt, aluminium, chromium, etc. Specimens of glass and related aqueous solutions were exhibited to illustrate the points discussed. Data on the treatment of glass included recent developments in etching, polishing and silvering processes. The importance of careful and comprehensive research in this

branch of industrial chemistry, and the necessity for endowment of such research, were emphasized.

New Volumetric Determination of Nickel and Cobalt: W. D. Engle and R. G. Gustavson.

Preliminary Report—Deposition of Copper in Electrotyping Baths: W. Blum, H. D. Holler, H. Rawdon and E. L. Lasier.

From a study of the microstructure and physical properties of copper, deposited upon graphited wax molds in the copper sulphate-sulphuric acid bath, the effects of the composition and temperature of the electrolyte and of the current density, upon the character of the deposits, have been determined. The conditions for the production of satisfactory electrotype shells have been defined. The relations between microstructure and physical properties, and the effect of annealing, are being investigated.

Let's Abolish Our Unnecessary Waste of Potassium Compounds: James K. Withrow.

Attention is called to the fact that in case of sudden cessation of imports great hardship is done not only to chemical users of potassium compounds but many manufacturers of miscellaneous materials who are not in the category of chemical manufacturing and who do not have chemical advice to assist them in meeting the emergency on which they are thrown. A strong appeal is made for publicity in eliminating all unnecessary use of potash so that hardship will be avoided in such cases, and to give manufacturers of sodium compounds ample opportunity to build up their supply under non-emergency conditions. All of this, so that in case of great national emergency, we may direct our attention as much as possible to other situations which can not be avoided by any previous arrangement. Attention is called to the fact that in our schools and colleges our chemical texts persistently require the use of potassium compounds where experience has shown that sodium compounds would do just as well. If we can eliminate this and similar unnecessary waste the percentage saving may not be so great but the educational value can not be estimated for it is quite common for enormous amounts of potash to be wasted in ordinary manufacturing and everyday life as well as in chemical operations.

Experiments on the Corrosion of Iron and Steel: W. D. Richardson.

Ethyl Alcohol from Wood Waste. IV. Yields from Various Species of Wood: F. K. Kressmann.

A Note on "Tars" from Some Mid-western Cannel Coals: John C. Ingram.

Cannel coals from Missouri and Illinois were distilled at 800° C. in iron retorts and the "oil" or "tar" collected. Yields of water-free tar varied from 30 to 50 gallons per ton. A typical sample (gravity 0.906) gave on distillation the following fractions:

To 150° C.	12 per cent.	Gravity	0.752
150°–200°	6 per cent.	"	0.788
200°–240°	9 per cent.	"	0.820
240°–270°	8 per cent.	"	0.880
270°–300°	16 per cent.	"	0.912
300° to coke	35 per cent.	"	0.945

The tars are largely made up of paraffin hydrocarbons, but seem to contain about 7 to 8 per cent. of tar acids. On standing these tars separate into two layers, the lower layer is semi-solid and shows a partial segregation of heavy paraffines. On centrifuging, four distinct products are obtained.

		Gravity
(1)	In bottom ..tar (mainly aromatics)	1.02–1.06
(2)	1st liquid.....water	
(3)	2d liquid.....heavy, viscous liquid	.96– .98
(4)	3d liquid .....light oil	.79– .85

Comments on the Krebitz Process of Soapmaking and Glycerol Recovery: G. A. Wrisley.

After double decomposition of the lime soap with soda ash, the soap is salted out and the lime $CaCO_3$ allowed to settle. It was impossible to prevent occlusion of 10 to 20 per cent. of soap. Attempts to wash out the soap by a series of washings and filtration were unsuccessful, because of slow filtering and loss of 5 to 10 per cent. of soap in the lime cake. It was found that on adding water to this mixture with thorough agitation a point was reached where the lime sludge settled out occluding only 3 to 5 per cent. of soap. This mixture was filtered easily and less than 1 per cent. of soap was lost in the lime cake.

An Unusual Explosion in Connection with Potassium Chlorate: F. E. Rowland.

Laboratory Control in the Manufacture of Corn Syrup: A. P. Bryant.

Effect of Aging upon the Constants of Chinese Wood Oil: D. F. McFarland and H. R. Lee.

Effect of Fillers in Synthetic Molding Compounds: L. V. Redman, A. J. Weith and F. P. Brock.

Printing Plates from Phenol Resins: L. V. Redman, A. J. Weith and F. P. Brock.

The Effects of Moisture Introduced into the Digester in the Cooking of Soda Pulp: Sidney D. Wells.

(To be continued)

Charles L. Parsons
Secretary